MODERN REFRIGERATION

AND AIR CONTROL

Vol. 64 No. 760 JULY, 1961 Price 2s. 6d. monthly

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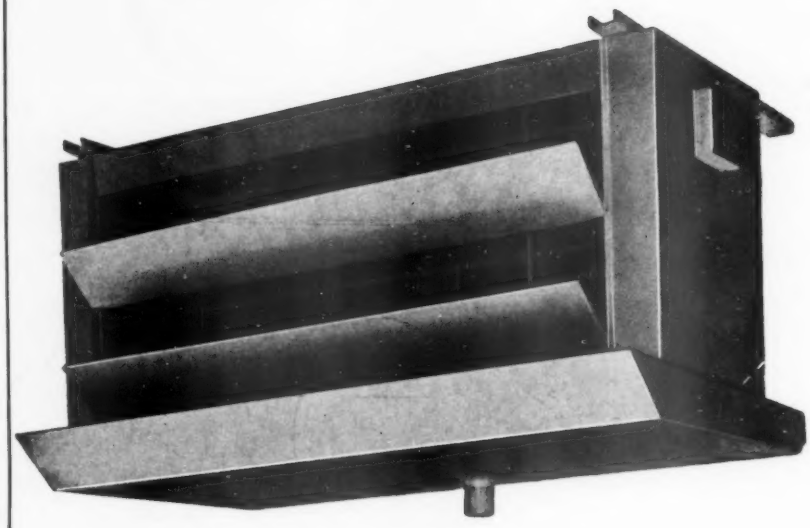

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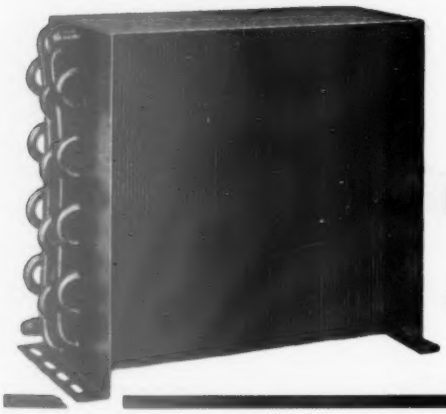

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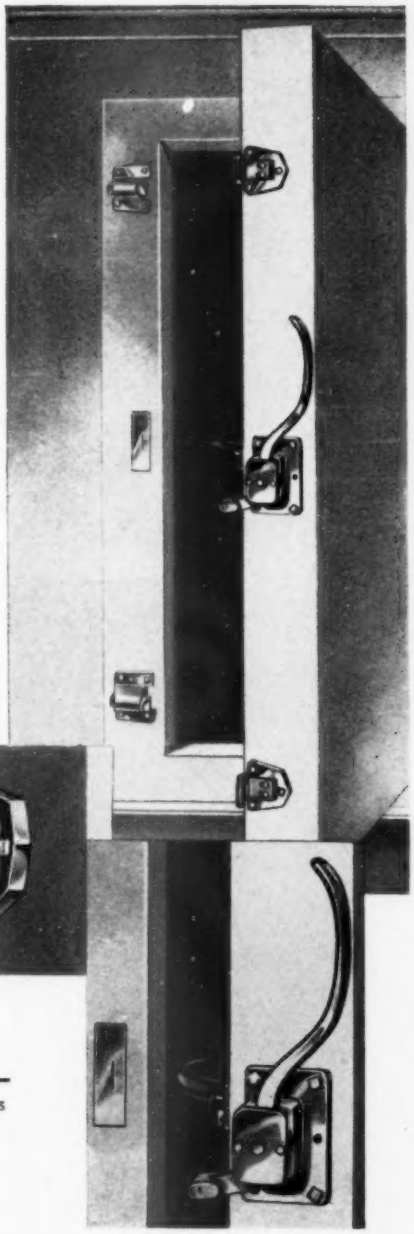

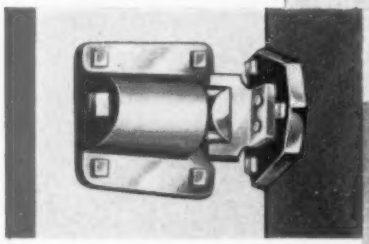

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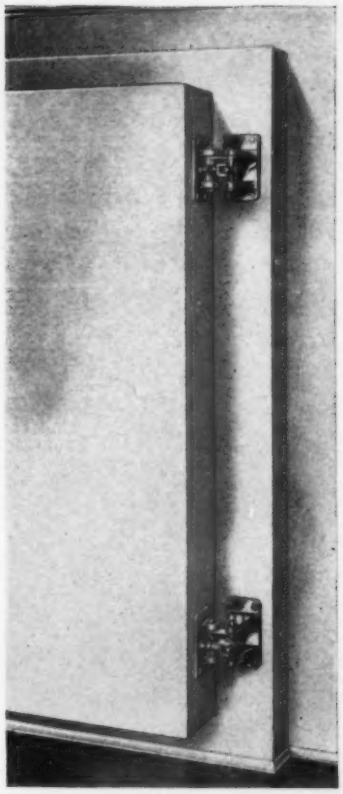

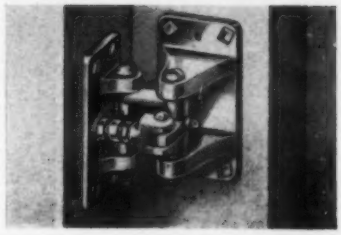

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many of them made by Frigidaire.
But if we had to choose our
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Proprietary Perfumes Limited, The Central Perfumery Organization for Unilever Limited, called in Frigidaire to solve a problem in their distillation plant. Uncondensed vapour was contaminating the lubricant in the vacuum pumps.

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Proof of this is that time and again you find Frigidaire installations doing jobs where reliability is vital. Just one example—the Frigidaire units you find preserving life-and-death drugs, in so many hospitals!

Your Frigidaire Distributor is YOUR OWN expert!

As a Frigidaire-user you are in a unique position. As well as having the world's finest refrigeration equipment, you have virtually a complete "Frigidaire organization" to give advice and service. Our reputation is ensured by every Distributor giving you *complete* Frigidaire service—day and night.

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Fortnum & Mason chose Frigidaire for the new provisions hall of their fine Piccadilly shop. It wasn't just a matter of trouble-free refrigeration. The units *had* to blend with existing decor. So special oak-panelled cabinets were produced, combining latest cooling techniques with exquisite woodwork. Just one example of Frigidaire versatility, and the specialized service we offer our customers. (We also provide refrigeration for Fortnum's flower room and new travel patio!)

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The refrigeration name everyone respects

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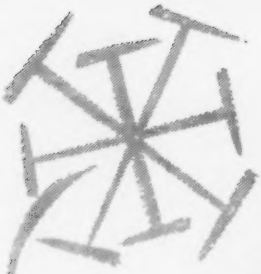

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AIR CURTAINS FOR OPEN COLDROOM DOORS

- COMPLETELY UNIMPEDED DOORWAYS!
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- ★ In the ISOL range—6.5 cu.ft. to 20.5 cu.ft.—there is a model to suit the exact requirements of your customer.
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control

and eggs don't always see eye to eye (as Humpty Dumpty learnt to his cost). Yet Blondin, you remember, thought nothing of nipping on to his high wire with one, to fry and eat it on the spot, poised above Niagara! Perfect control, it's the finest of arts, yet it looks deceptively simple. Today, of course, it *is* simple—when you leave it to Ranco. Whatever the refrigeration application you have in mind, Ranco has exactly the right control all ready for it. And with Ranco controls you're completely assured of faultless performance under any service conditions. Of this *we* make sure by testing and re-testing every single thing we make before it leaves our hands.

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Models are available for freezers—and domestic refrigerators.

You earn important savings with a Tiny-T model compressor . . . less cost, less weight, less size than previous single cylinder internally spring mounted compressors.

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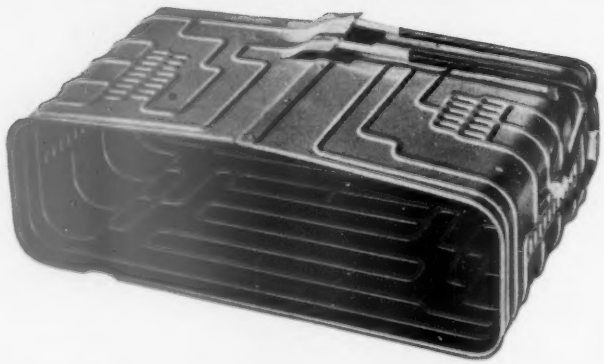

Marston Excelsior Ltd.,
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Evomastics Ltd. produce a very wide range of specialised mastics which solve an infinite number of sealing problems. Whatever your problem, be it joint movement, galvanic corrosion, temperature, solvents or just plain weather, the technical resources of Evomastics are at your service to give you the right answer. The methods of application of mastics are also an important consideration to which Evomastics give close attention and you can be sure of a quick, clean and economical job when you work to their recommendations.

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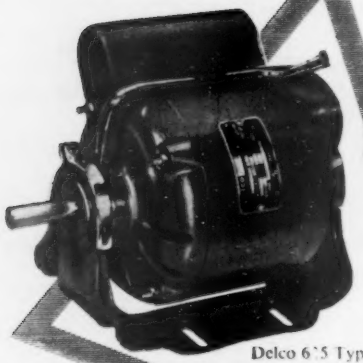
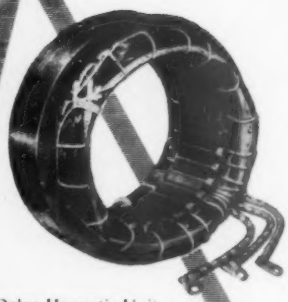


Delco 675 Type



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for silent power

DELCO electric motors

Delco 650 Type

If you are designing new refrigeration equipment or redesigning old, you will find a Delco motor that's just right for the job. In addition to the renowned silent dependability there are exclusive features which make a Delco Motor the obvious choice for high quality equipment. Call in a Delco Engineer now to discuss present and future requirements, or write for further information.

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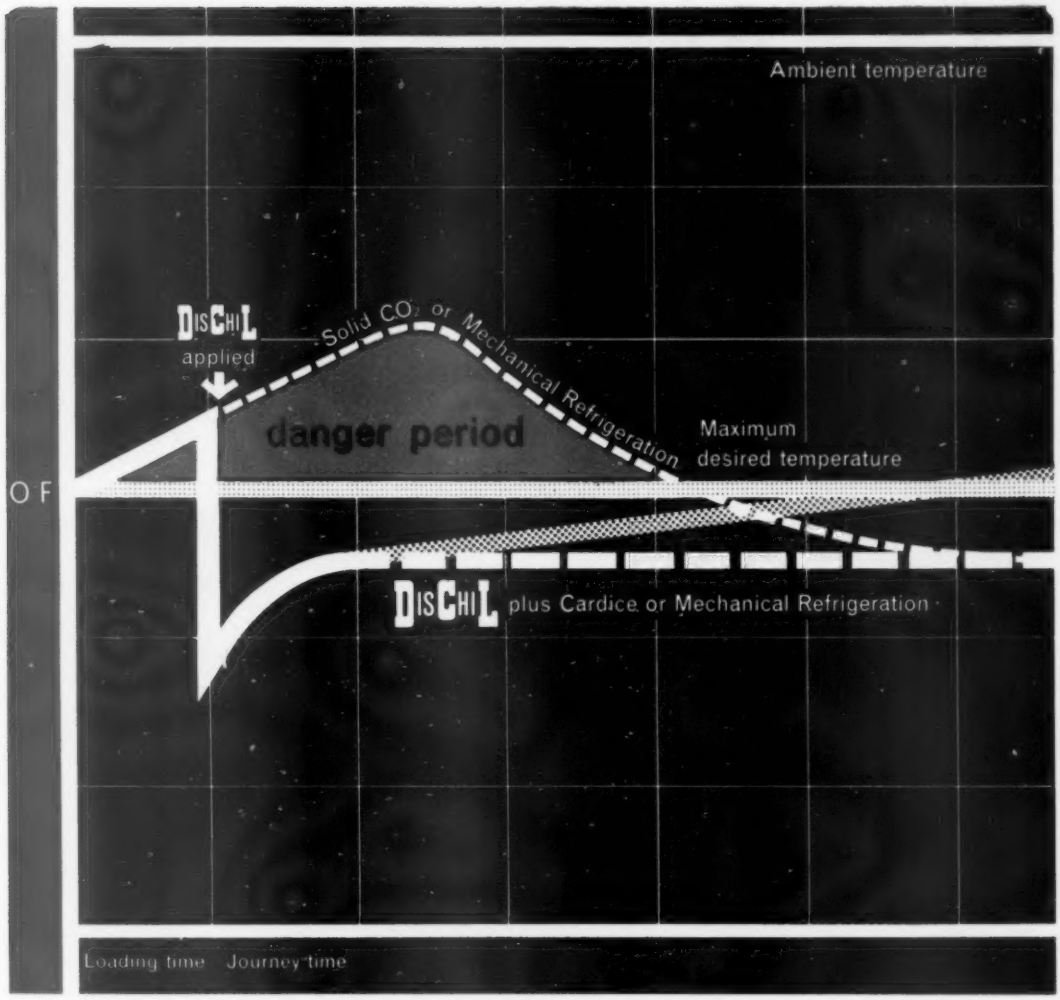

Cut out the danger period. While the container doors are open, the goods and vehicle shell take in heat. The container fills with warm air, bacteria and moisture. Normal systems of refrigeration may take six to eight hours to reduce temperature to the desired level.

DisChiL FOOD PRESERVATION SERVICE

–gives immediate temperature drop

The DisChiL System pulls down the temperature in seconds after loading. The vehicle's own refrigerant has nothing to do but keep it down. If you will write to us, we will be glad to explain in detail.

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Carbon Dioxide Department, Devonshire House, Piccadilly, London, W.1.
Telephone: MAYfair 8867

Sales Offices: Southern Area: Broadway House, The Broadway, Wimbledon, S.W.19. Tel: Liberty 4661
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KENMORE DRIERS

Strainers – Accumulators – Heat Exchangers

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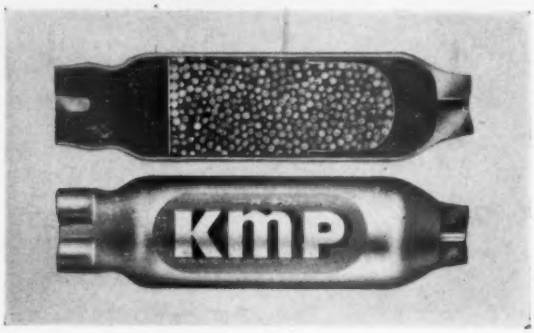
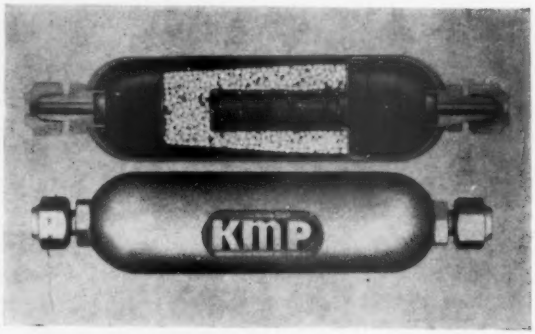


Kenmore can supply a wide range of driers with standard connections or made to your specific requirements. The double inlet drier is KMP's newest design, this additional connection enables you to pull a vacuum on the high side of the system, which reduces the process time and ensures complete system evacuation. The single inlet drier can be supplied if preferred.

"The Little Giant"—For general field use on hermetic and open units up to $\frac{3}{4}$ h.p. using R.12. This drier comes to you dehydrated and sealed to ensure perfect dryness of the Molecular Sieve. KMP have designed this drier with the Service Engineer in mind, as the connections can be quickly flared or soldered to suit any application from capillary tube to $\frac{1}{4}$" flare.



Driers having flare fittings can be supplied filled with Molecular Sieve or Silica Gel. The large filter area incorporated in this range of driers ensures dirt free refrigerant throughout the system.

Kenmore Products are now available in this country, thus Kenmore can give you the quality, economy and service enjoyed by 80% of the Refrigeration Manufacturers in the United States of America.

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SERVICE DRIER STOCKISTS :

REFRIGERATION SPARES LIMITED
31 HARROW ROAD, E.11 Tel. No. Maryland 2788

KMP

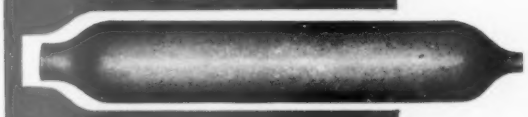
KENMORE INC. A.S

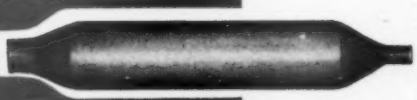
FACTORY : AARNES STATION — NORWAY
Cable Address : Kenmore, Oslo

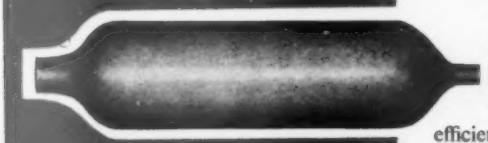
DAVID SCOTT
NEW Molecular Sieve DRIERS

LOW INITIAL COST *PLUS* 9 times greater efficiency than Standard Driers

The Sieve Driers that Save







This is good news for all sealed refrigeration system manufacturers. David Scott high side molecular sieve driers are now nine times more efficient than standard driers. With a desiccant consisting of a molecular sieve filled with type 4A 8 x 12 mesh beads, they have actually nine times the normal adsorption. Consider the economic advantage. With David Scott high side driers you save size and weight.

FIRST CLASS CONSTRUCTION

Construction of these remarkable new driers is carried out in spun copper shell with a desiccant between two fine-mesh strainers. Outlets screen is of bag construction with secure retention in a brass ring pressing. This is formed from a 150 mesh twill weave wire cloth or equivalent in either phosphor bronze or monel.

PRE-PURCHASE PROTECTED

The greatest care is taken to ensure 100% efficiency. All driers are manufactured and stored in an air-conditioned atmosphere.

EASY AND SAFE TRANSPORTATION

Though there is the minimum risk of moisture adsorption from the surrounding atmosphere, David Scott new high side driers can be individually sealed before leaving the factory. All driers are shipped in hermetically sealed canisters.

Inlet and outlet connections conform to manufacturers own requirements.

Other David Scott products include RECHARGEABLE DRIERS from ¾" o/d to 1¾" o/d pipe, and ACCUMULATOR DRIERS with copper shell squeezed and silver soldered at each end.

★ *A special feature of the David Scott service is the manufacture of driers to clients own specifications.*

David Scott
AND COMPANY LTD
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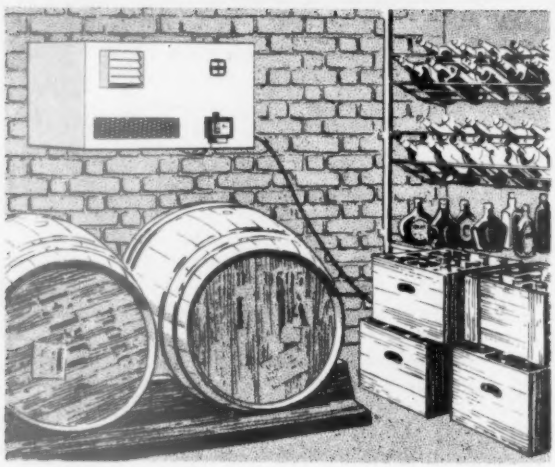
HPR

cellar cooler specially designed for small cellars

This low priced unit is extremely efficient quiet, economical to run and simple to install

Dimensions :
Height 15″ Width 27½″ Depth 22″ Weight 155 lbs.



Price £115 ex works

This is the first unit to be expressly designed to cool small cellars (1,500—2,000 cu. ft.). H.P.R. design and "know-how" give you the maximum efficiency and economy from a unit of the right size for small cellars.

Larger units are available for larger cellars, and H.P.R. can advise on the minimum sized unit necessary to meet requirements.

For further particulars, please write to :

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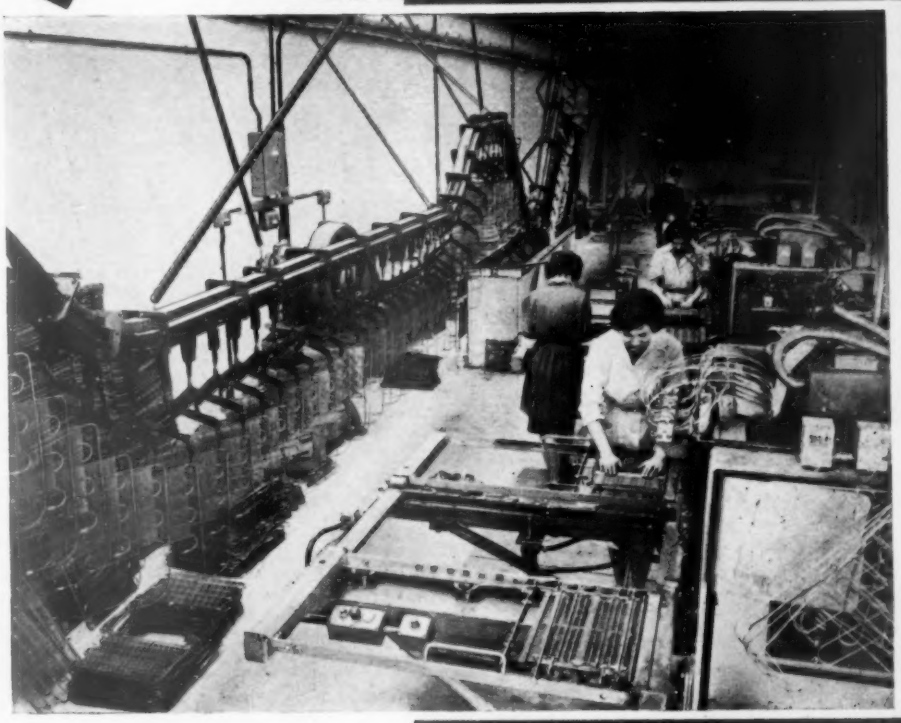
Heat Pump & Refrigeration-Scottish Ltd., Prestwick Airport, Ayrshire, Scotland. Prestwick 79888

EFFICIENT REFRIGERATION NEEDS SCOTT CONDENSERS

...and here is a section of
the most up-to-date plant
in Britain for the production of
REFRIGERATION CONDENSERS



Scott condensers are made in the most modern factory in the country with fully automatic multiple spot welding equipment capable of coping with condensers up to 20 rows and up to 128 wires with a maximum length of 2¼ pitch.
Full information on request.

DAVID SCOTT
AND COMPANY LTD

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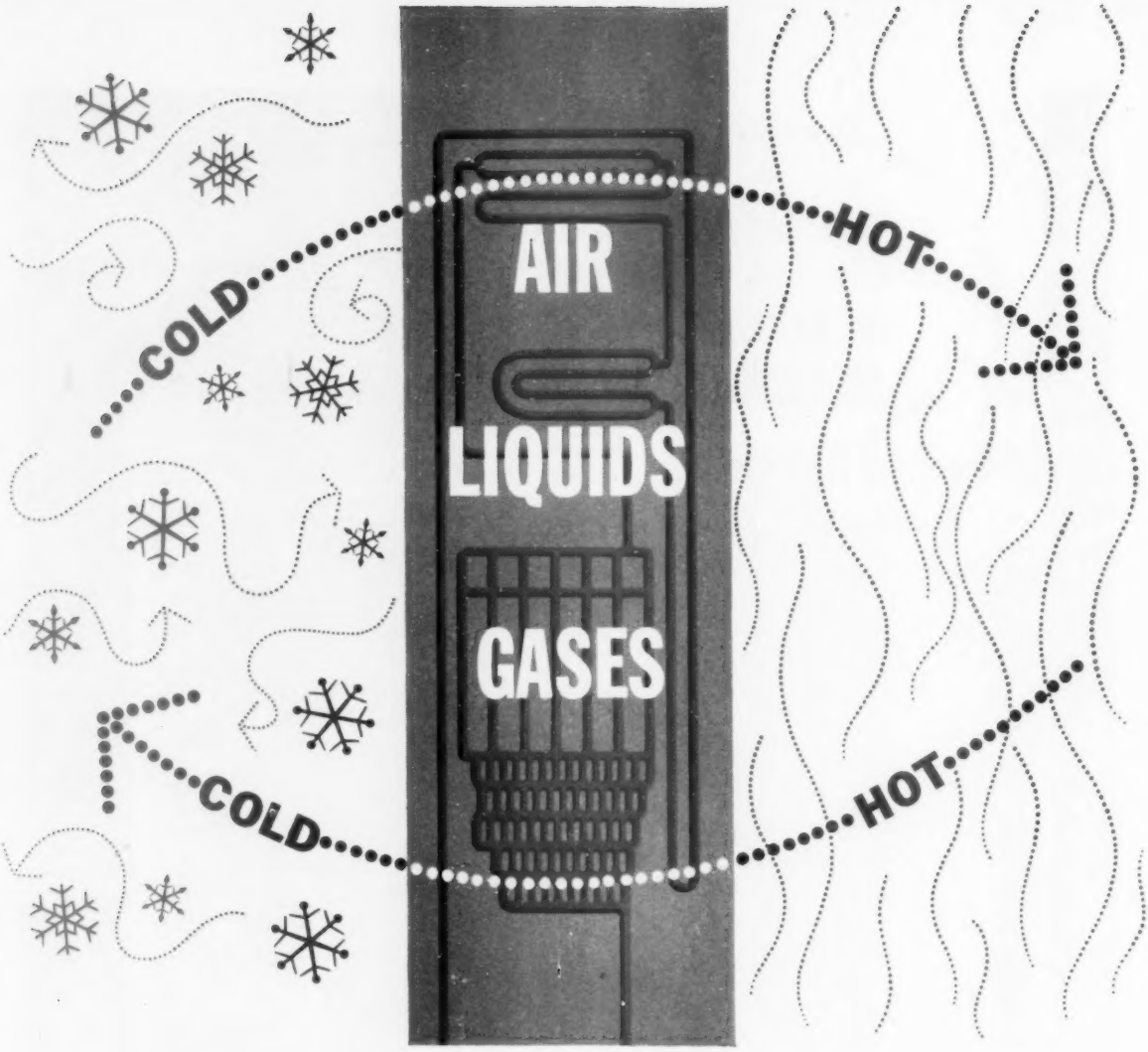


Heat transfer—hot to cold, cold to hot—is the specific purpose of two important **IMPALCO** products. These highly specialised heat exchange products—Roll-welded Heat Transfer Sheets and Tube-in-Strip—are made by advanced techniques from high quality materials.

impalco aluminium

Imperial Aluminium Company Limited · Birmingham

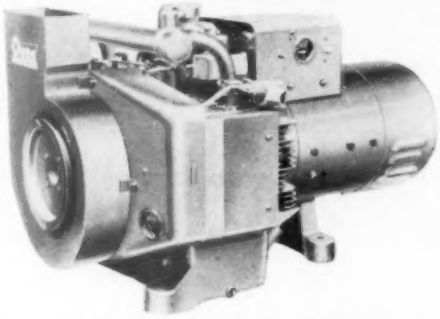
ONAN

THE GENERATING SET *ENGINEERED* FOR REFRIGERATED VEHICLES

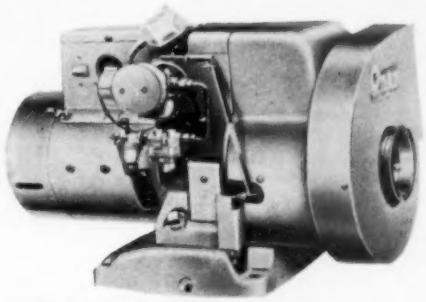
Onan Vacu-Flo cooled packaged Generating Sets provide ample power for the operation of electrically driven open and sealed type refrigeration units giving High Performance with long life, minimum operating and maintenance costs.

Vacu-flo Cooling System

Exclusive to Onan—overcomes cooling problems in confined space. Cooling air is drawn through and over the generator and engine and exhausted through an outside duct.



ONAN 5CCK Generator with Vacu-flo Cooling gives 5 k.w. of packaged power and will handle refrigeration units of up to 3 h.p. Model 305 CCK meets the requirements of units up to 2 h.p.
LOOK AT THE WEIGHTS—5 k.w. Model ONLY 375 lbs., 3½ k.w. Model ONLY 314 lbs.



ONAN Model 205AJ-2RV with Vacu-flo Cooling Ideal for mounting in sound-proofed compartment in Refrigerated truck or mobile shop for the operation of Refrigeration Compressors up to ¾ h.p. Frozen Food Display Cabinets or for providing power and light for mobile sales and display vehicles. Built for long life and quietness of operation. Full details on request.

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Our After-Sales Service is unmatched by any other suppliers.

G.M. POWER PLANT CO. LTD.

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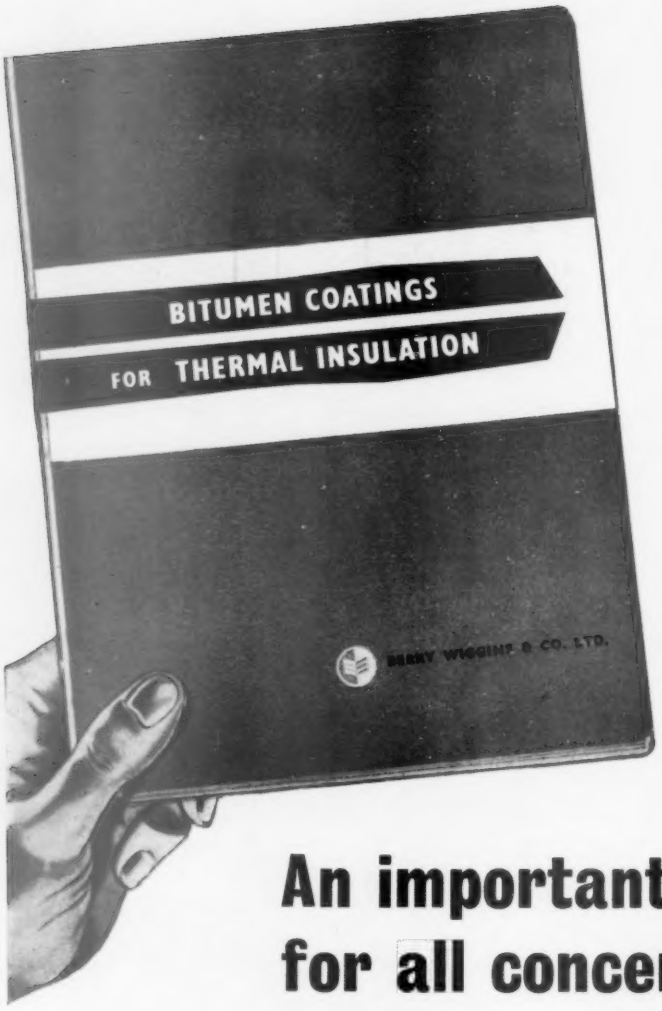

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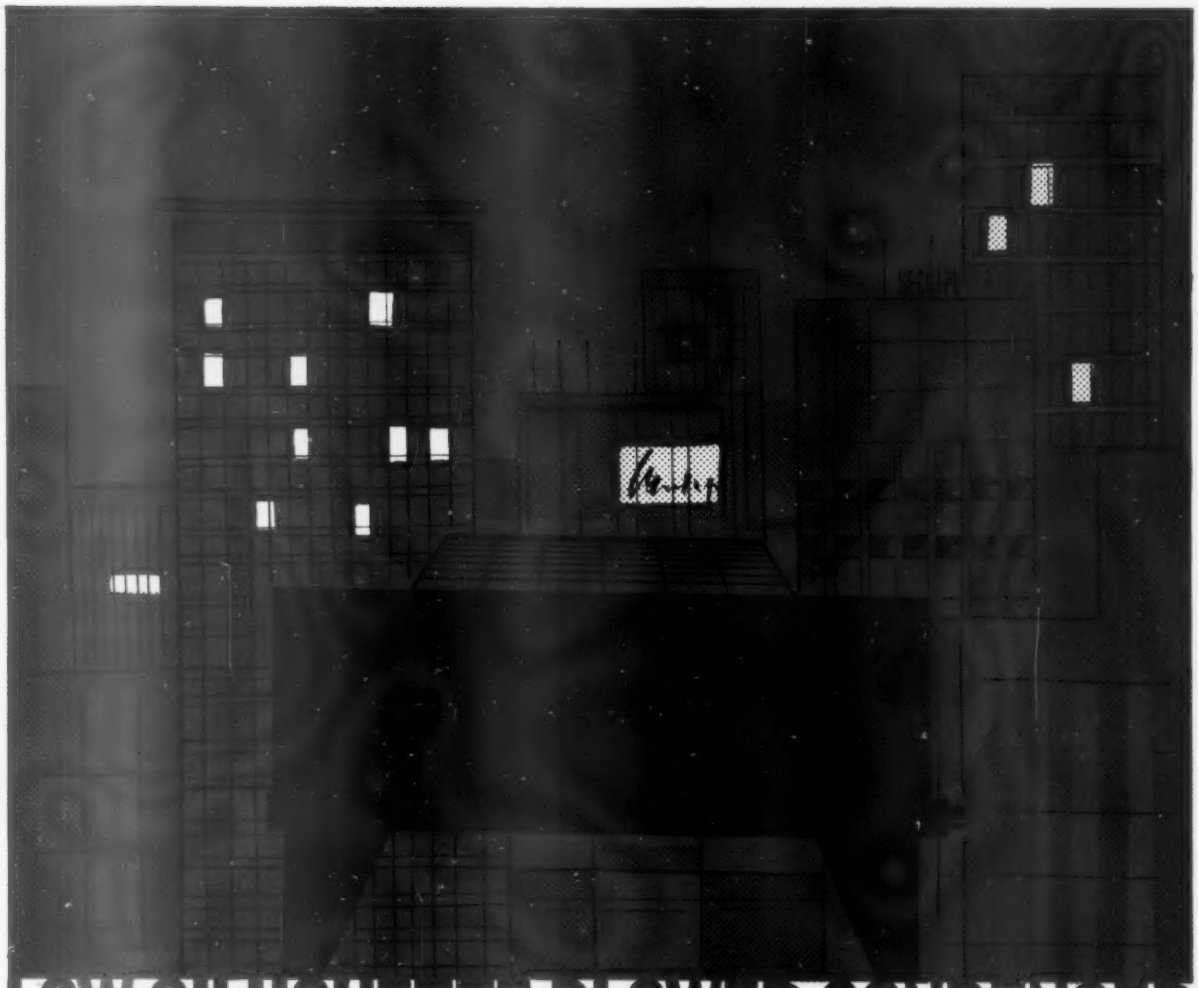

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	CENTIGRADE	FAHRENHEIT
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ISCEON 11 (CCl_3F)	23.8°	74.8°
ISCEON 21 ($CHCl_2F$)	8.9°	48.0°
ISCEON 114 ($CClF_2.CClF_2$)	3.6°	38.4°
	0°C	
ISCEON 12 (CCl_2F_2)	—29.8°	—21.6°
ISCEON 22 ($CHClF_2$)	—40.8°	—41.4°
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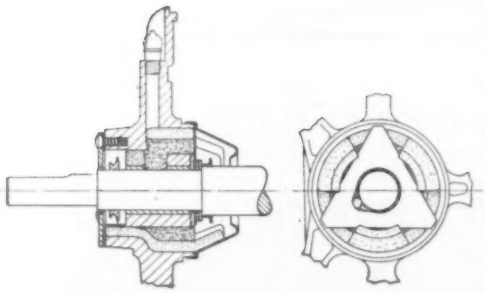

This bearing is an excellent example of that part of engineering design that stems from experience rather than theory and is covered by the possibly ugly but certainly indispensible term — know-how. The oil cavity is large and filled with highly absorbent felt which, acting as a wick, circulates the oil continuously, and which also acts as an oil filter. The thrust is taken on a bakelised washer supported by a steel washer, bearing on a triangular plate of spring steel which cushions the end thrust. The thrust faces are lubricated by the felt projecting through a D-shaped opening in this plate. These bearings run silently without attention for a year or more at a time.

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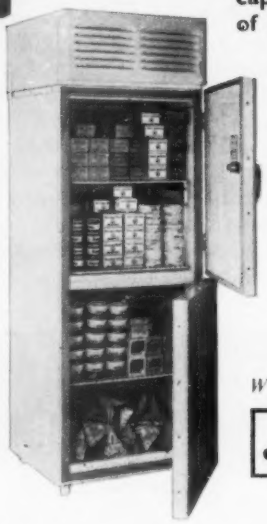

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Adjustable polythene shelves.

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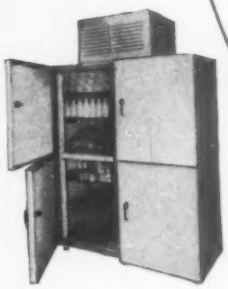
Meets all food regulations.



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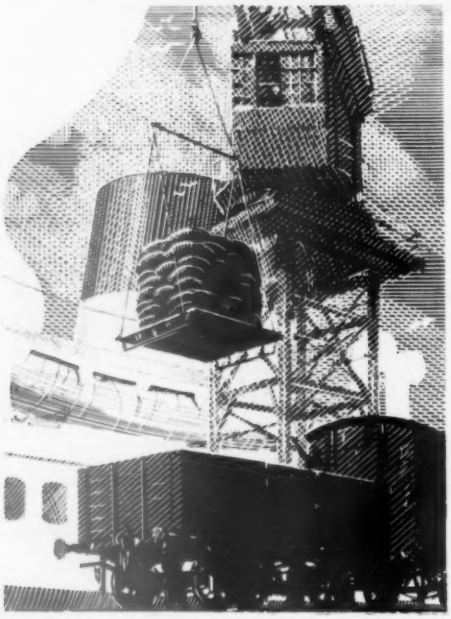

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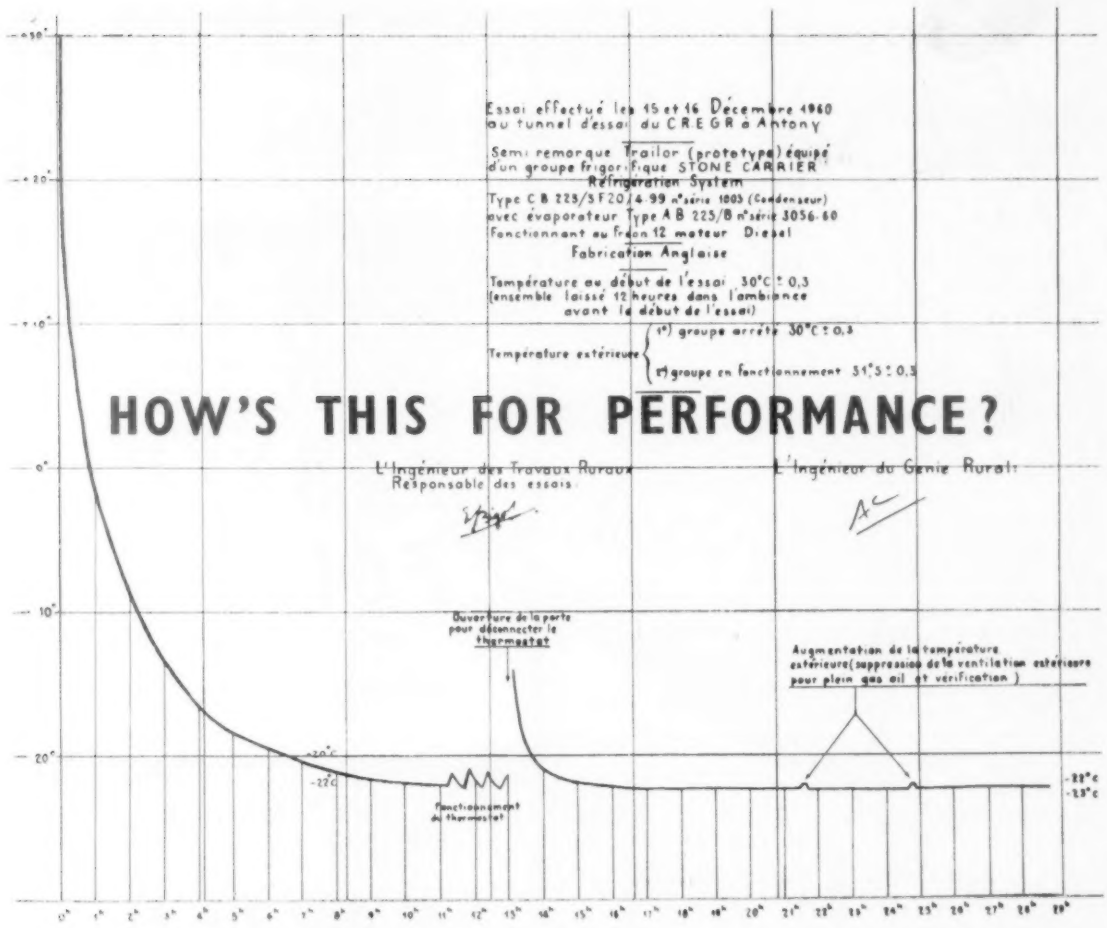
Essai effectué les 15 et 16 Décembre 1960
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Semi remorque Trailor (prototype) équipé
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Refrigeration System
Type C B 225/S F 20/4-99 n°série 1003 (Condenseur)
avec évaporateur Type A B 225/B n°série 3056-60
Fonctionnant au fréon 12 moteur Diesel
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Température au début de l'essai 30°C ± 0,3
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Température extérieure
1°) groupe arrêté 30°C ± 0,3
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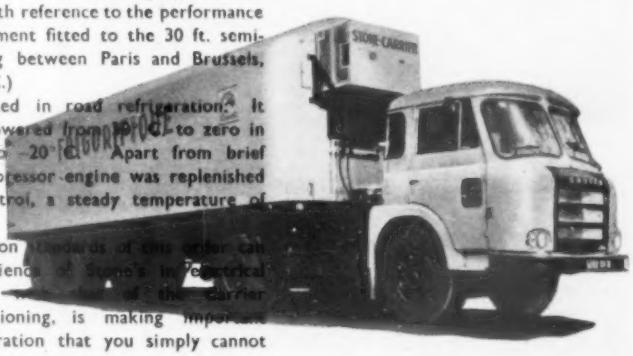

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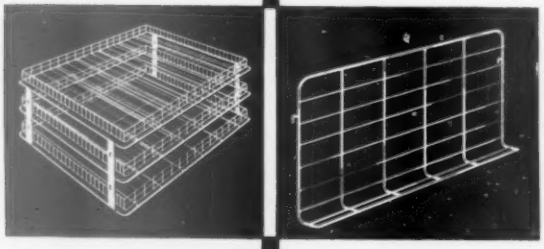

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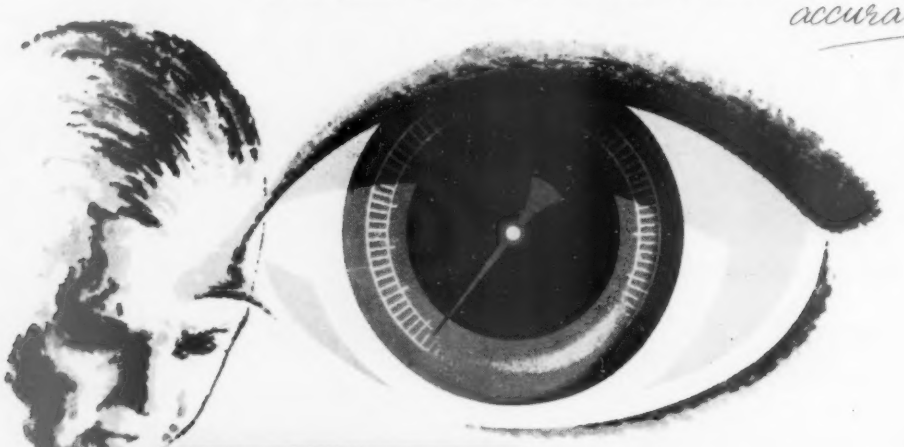

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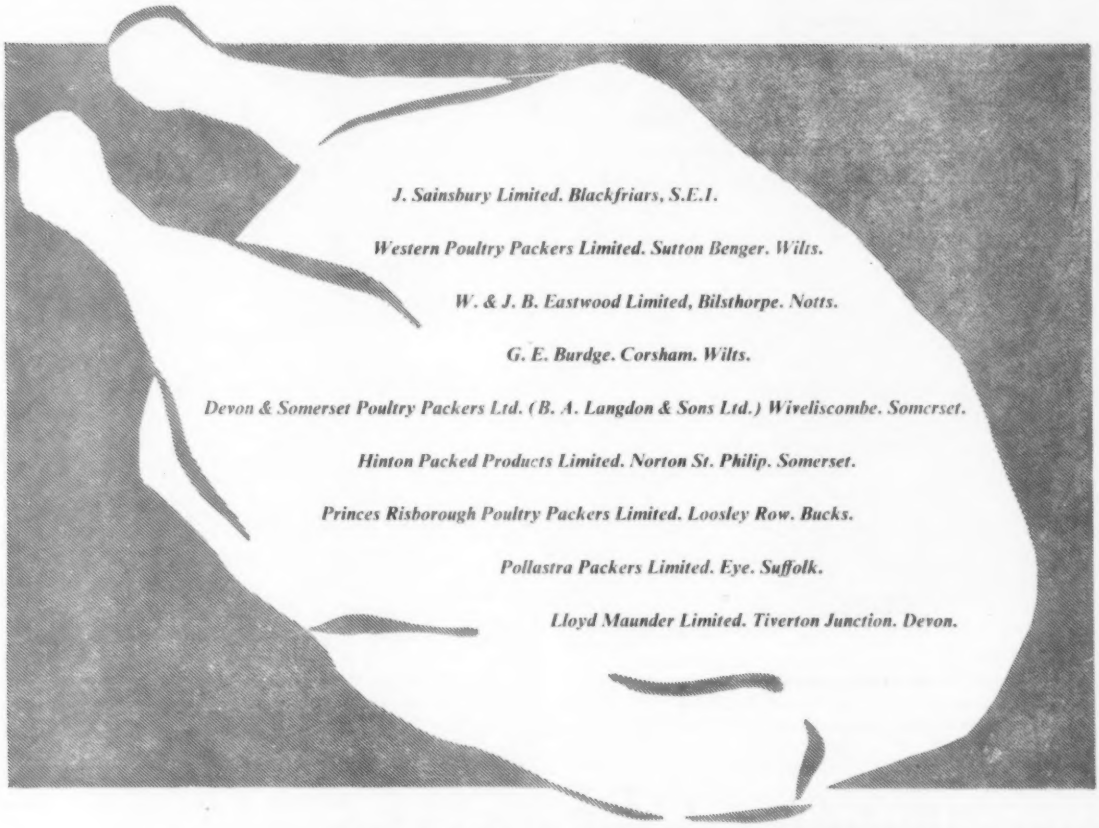
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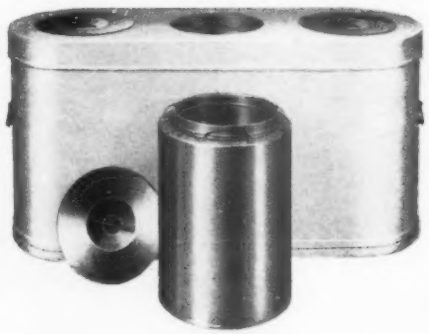

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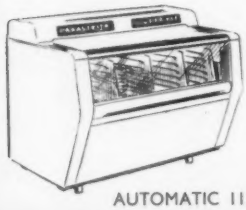

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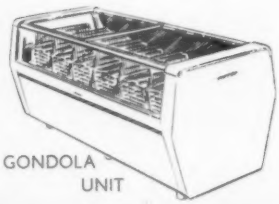

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REFRIGERATION SERVICE ENGINEER required for Mid-Essex. Must be conversant with Freon equipment up to 5 h.p. including Supermarket equipment. Good rate of pay, plus overtime rates, sick pay and bonus after trial period. Good opportunity for first-class Engineer. Apply to Box 316. 316

REFRIGERATION APPLICATIONS ENGINEER required by Frigidaire Distributors. Good remuneration and conditions. Write with full details to R. E. A. BOTT (Wigmore St.) Ltd., 28, Wigmore Street, London, W.1. 317

ENGINEER required in medical laboratory for maintenance of specialised refrigeration plant (Freon 12 and 22) and associated developmental work. Pension scheme, canteen, transport available from Boreham Wood, Elstree and Bushey Heath. Write stating age and experience and with names and addresses of two referees to Secretary, Lister Institute of Preventive Medicine, Elstree, Herts. 318

SERVICING ENGINEER required for progressive private Company in London area—mainly domestic and light commercial—apply in confidence to Box 319. 319

REFRIGERATION ENGINEER required, capable of Domestic and Commercial, to join expanding North London Company. With or without capital. Profit sharing, with view to Directorship to experienced hard-working man. Full details, age, experience, etc., to Box 323. 323

APPLICATIONS ENGINEER

required by

London Distributor

Capable of dealing with enquiries from salesmen on a variety of applications.

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Non-Contributory Pension Scheme, etc.

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REFRIGERATION ENGINEER, A.Inst.R., Scotsman, Age 38, returning United Kingdom October 1961, after nine years East Africa with Prestcold Agents, desires permanent position at home. Box 306. 306

Absorption-Refrigeration

3-12 c.ft. in electricity, gas, kerosene. Recognised expert in development and production, managing since 11 years most important production line in Brazil using his own techniques and designs, wishes to change climate. Swiss, 60 years, speaking English, French, German, Portuguese. Available spring 1962. Personal contact possible August 1961 in Europe and U.S.A. Serious concerns interested in new types of units, or in starting absorption production, or in permanent or temporary consulting assistance, are invited to write to Box 61, Publicitas Export Section, Lausanne, (Switzerland). 294

ARTICLES FOR SALE (Secondhand)

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APPROXIMATELY 100 Domestic second-hand Refrigerators for sale—no reasonable offer refused —individual or bulk Purchasers welcomed. Telephone MOUntview 3111 for appointment to view. 266

REFRIGERATION Cabinets second-hand, between 1½ to 40 c.ft. The A.C.R.E. Company, 389 Green Lanes, London, N.4. MOU 0171/2. 1364

CONDENSERS: Several large water economiser Condensers complete with fans and pump, capacities 40 and 60 tons refrigeration, for sale. Good condition. Also large stock of brine/water pumps 1 in. to 6 in. cheap to clear. Seen London. Alfred's Ices, 1/5 Hall Place, London, W.2. 239

STERNE TECUMSEH SEALED SYSTEM 5/7 cubic ft. 10 guineas each. Wilde & Clayton (Refrigeration Ltd.), 1 Hindsley Place, Forest Hill, S.E.23. Phone: FOR. 8851. 309

TWO Shell and Tube condensers by Hall, virtually unused, 90 tons refrigeration capacity each. Particulars from: G. W. A. JONES, 15, Lancaster Gate, London, W.2. PAD 4317. 321

ARTICLES WANTED

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AMMONIA Refrigeration Compressors (Vertical) wanted by Hall, Sterne, Lightfoot with accessories, including Atmospheric Condensers—Offers: G. W. A. Jones, 15, Lancaster Gate, London, W.2. Telephone Paddington 4317. 236

LARGE Ammonia compressors wanted, Alfred's Ices (1954) Ltd., 3 Hall Place, W.2. 288

DOOR FASTENERS and handles required by Manufacturers of a small commercial type of Cabinet. The doors are quite light and the handle should be at least equal in modernistic appearance to the most modern type of domestic. Quantities expected to be in 100 lots to start with. Please send illustrations and fullest details to Box 308. 308

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SECTIONAL cold rooms for all temperatures up to 5,000 cubic feet capacity. Highest quality, competitive prices. Trade enquiries invited for illustrated leaflets and quotations. Insulated Storage and Display, 28-30 Hempsted Lane, Gloucester. Telephone 20649. 249

POLYTHENE Coated Steel Shelves, Freezer and Supermarket Baskets, Hygienic Corrosion Proof White Polythene. Special Discounts for Quantities. Richard Craven & Co. Ltd., Camwal Road, Starbeck, Harrogate. Telephone 84484. 203

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FOR SALE—Cold Storage business—North West area comprising: 50,000 c.ft. 12/16°; 20,000 c.ft. minus 5; 20,000 c.ft. Chill Room; Blast Tunnel minus 20—2 tons capacity, also good dry storage space available. Details from Box 311. 311

THE WINGET-DOLE TRUCK-CEL COMBINES FORCED AIR CIRCULATION AND HOLDOVER

A compact, light, yet robust Holdover Blower Unit for refrigerated transport that maintains uniform temperatures (+34° to +40° F) with the utmost reliability on both short and long hauls. The fan at the top of the unit draws air over the cold plates and circulates it throughout the body. Available in two types, CHO (complete holdover) for night pull-down operation, and PHO (partial holdover) for 'over-the-road' use, the Truck-Cel is exceptionally easy to install and comes in sizes to suit individual vehicle requirements.

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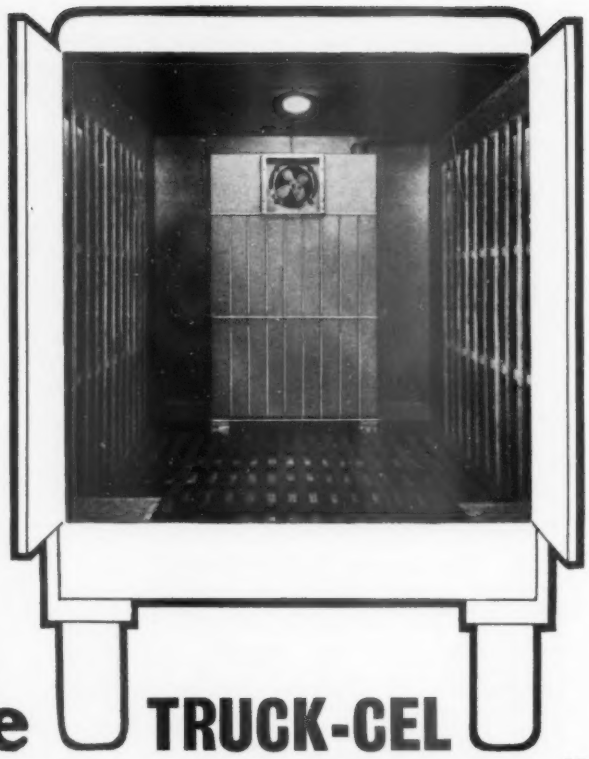

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and Air Control

Incorporating
COLD STORAGE AND PRODUCE REVIEW
and ICE AND COLD STORAGE

Established 1898

VOLUME 65 NUMBER 759

JULY · 1961

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MODERN REFRIGERATION *overseas*

The world-wide circulation of this, the original and oldest journal of the British Refrigeration Industry, carries "MODERN REFRIGERATION" by postal subscription into the following countries:—

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Editorial...

Kruschev Impressed

Featherbedding Soft Fruits

"Domestic" Sales Still Disappoint

● Those refrigeration firms who took their courage in both hands and supported the British Trade Fair in Moscow seem to have been well rewarded by their participation. To coin a phrase, faint hearts ne'er won business at the Fair and it is most encouraging to see that refrigeration firms contributed more exhibitors than many other larger sectors of the engineering world. "Our Man in Moscow" reports on the event in this issue; on this occasion he was not from our editorial staff but was a member of one of the largest refrigeration firms in the industry. Our thanks are due to him for undertaking this assignment on our behalf.

● These refrigerationists returning from the British Trade Fair, Moscow, may find of special interest a new bibliographical reference work covering 922 articles dealing with results of research work and of practical experiments that have appeared in the proceedings of 41 Russian research, training and project designing institutes during the period 1933 to 1958. Classification is in three main sub-divisions: (1) project and design engineering and technical operation; (2) treatment and refrigerated transport of food products; (3) technology and engineering of refrigeration and air conditioning. These are sub-divided under a total of 54 headings. The publishers have made arrangements with the U.S.S.R. Academy of Sciences whereby translations of any article in this bibliography may be obtained under a cost-sharing plan. The book is entitled "Soviet Refrigeration Technology" and is by D. N. Prilutskii. Publishers are Permagon Press.

● Experimental consignments of pre-cooled strawberries and raspberries are being marketed in Great Britain this summer under the auspices of the Horticultural Marketing Council. The experiments started last month. Pre-cooled strawberries were sent regularly from the Swanwick area of Hampshire to markets in the north of England and Scotland during June. Pre-cooled raspberries will be despatched from the Blairgowrie area of Scotland to markets in the south of England during July and August. The object is to show that pre-cooled soft fruit can be distributed safely and economically over greater distances than uncooled fruit while retaining its quality and freshness for a longer period.

● These experiments, it is hoped, will establish whether it is commercially possible to market pre-cooled fragile and perishable soft fruit, thus giving the housewife better value for money—and possibly a wider choice—and the grower a better return. During the experiments the Horticultural Marketing Council will collect information, for eventual publication, about: (a) comparative costs—between methods of cooling and transport, as well as between cooled and uncooled fruit; (b) comparative returns; (c) comparative condition through to the retail shop. Last summer, British Railways, in conjunction with the N.F.U. and the Swanwick Fruit Growers' Association, despatched a number of consignments of pre-cooled strawberries by rail to Glasgow and London. The H.M.C.'s 1961 programme is taking those experiments a stage further by continuing work of the same kind, and by using new equipment and containers for road transport. In all, some 20 tons of strawberries and 18 tons of raspberries will be pre-cooled for transport by road and rail to markets at least 200 miles away. The longest journey will be made during August by a consignment of raspberries from Blairgowrie to Brighton—some 450 miles.

● Wholesalers will make sure that buyers know the fruit has been pre-cooled and will compare it with fruit which has not been through the same process. They will be reporting on the fruit, particularly comparative prices. More detailed technical examination at the market will be made by officers of the Ministry of Agriculture, Fisheries and Food, the Department of Agriculture for Scotland and the Horticultural Marketing Council. This examination will be carried through to retailers' shops where sample inspections will be made. As a further check on retail condition, reply paid postcards will be put in every third tray. The retailers will complete the card and return it to the H.M.C. giving information about condition and demand. If a consignment is to be transported by rail its quality and condition will be examined and recorded when the grower has brought the fruit to the pre-cooler at Swanwick station.

● April was a discouraging month for the domestic refrigerator industry. According to the latest figures issued by the Domestic Refrigeration Development Committee, manufacturers' deliveries of British-made domestic refrigerators to the home market during April totalled 103,019, as compared with 119,565 in April, 1960. This figure is 14 per cent. lower than in April of last year—and another disappointing month for an industry which is making every effort to increase the ownership of domestic refrigerators in this country. At present 22 per cent. of homes in this country have domestic refrigerators compared with 97 per cent. in the U.S.A. Exports in April totalled 12,232, a figure which is down by 17 per cent. on April 1960 when the figure was 14,720. Total exports for the first four months of this year—47,931—show an increase of 11 per cent. on April, 1960, when exports totalled 42,989.

Mr. Kenneth Lightfoot retires

MR. KENNETH LIGHTFOOT, O.B.E., retired at the end of June from the chairmanship of The Lightfoot Refrigeration Co. Ltd. and from the managing directorship of Lightfoot Cold Stores Limited. Thus, one of the most highly honoured names disappears from

our industry in which it has exerted a great influence since the late Mr. T. B. Lightfoot came on this industrial scene more than 80 years ago.

Mr. Kenneth Lightfoot was educated at Tonbridge School and Leeds University and served his apprenticeship with Davey Paxman & Co. Colchester, in general engineering, and with Dick Kerr of Preston (now English Electric Co.) in electrical engineering. He joined The Lightfoot Refrigeration Co. (then The Linde British Refrigeration Co. Ltd.) in 1908, and spent the first year calling on all users of the company's refrigerating plant in the United Kingdom, and the second year superintending the erection of large refrigerating plants.

In the first world war Mr. Lightfoot joined the East Surrey Regiment in September, 1914, transferring to Royal Engineers at end of 1915. He was sent out to Mesopotamia where ultimately he was in charge of all icemaking and refrigerating plant throughout that country, with the rank of major and title of assistant director of works, for which was awarded O.B.E. He returned to The Lightfoot Refrigeration Company on demobilization in 1919.

Mr. Lightfoot succeeded his father, Mr. T. B. Lightfoot, as managing director in 1921, which position he held until 1956, when he became chairman of The Lightfoot Refrigeration Co., and managing director of its subsidiary, Lightfoot Cold Stores Ltd.

Among the many leading positions he has occupied in the industry, as technical and commercial bodies may be mentioned :—

Member of The Institute of Refrigeration since 1909.

President of ditto, 1945–7, and elected vice-president for life. During his term as president, to mark the association between the name "Lightfoot" and Refrigeration, he instituted the annual award of the "Lightfoot" Medal.

President of National Federation of Cold Storage & Ice Trades, 1931 to 1937, and again, from 1940 to 1948.

Member of the National Cold Stores Committee formed as the cold storage industry's liaison with the Government for the running of the cold stores during the war.

Director of National Cold Stores (Management) Ltd., operating the Government-owned cold stores, a position he still holds.

Kelvinator Challenges the Government

Reductions in Refrigerator Prices

KELVINATOR announces sweeping reductions in the prices of its entire range of British-made household refrigerators in order to stimulate sales in the home market.

"The Government's policy in depressing home market sales in order to increase exports is mistaken, and is in fact having precisely the opposite effect," said Mr. N. F. T. Saunders, managing director of Kelvinator Limited.

"Some refrigerator manufacturers may unfortunately be forced out of business, but Kelvinator, a world-wide organization which made the first household electric refrigerator in the world, has no intention of going out of business.

"Kelvinator intends to maintain its position as the leading exporter of refrigerators, by reducing costs, and the only way to do this is to increase production by selling more in the home market.

"This is not a matter of sacrificing profit—our prices are already marginal, but we are prepared to reduce prices first in order to achieve the production which will make these prices economic.

"Also it is only by keeping up our output that we can find the money to keep our design and manufacturing techniques ahead of world competition.

"Our policy is to achieve volume sales consistently so that we can hold our prices down both home and export. I am sure the British housewife will understand and will respond to these new prices.

"Our new prices are:—

Lady K (K31M): capacity 3.1 c.ft., reduced to 45 gns., reduction £5 5s.

K46ZP: capacity 4.6 c.ft., reduced to 62 gns., reduction £5 5s.

K60M: capacity 6 c.ft., reduced to 72 gns., reduction £8 8s.

K77M: capacity 7.7 c.ft., reduced to 89 gns., reduction £15 11s.

K94M: capacity 9.4 c.ft., reduced to 106 gns., reduction £13 14s.

K94MD: capacity 9.4 c.ft., reduced to 110 gns., reduction £19 10s."

NEWS OF THE MONTH

Refrigeration and A-c Exports.—During May, 1961, air-conditioning and refrigerating machinery and fans (commercial and industrial sizes) to the value of £918,910 weighing 1,334 tons was exported from the United Kingdom. Comparable figures for May, 1960, were 1,043 tons, worth £753,663.

* * *

Exports' Analysis.—Of the 1,334 tons of air-conditioning and refrigerating plant worth £918,910 exported by Great Britain in May—quoted in the preceding paragraph—58 tons went to the Union of South Africa, 20 tons to India, 42 tons to Australia, 24 tons to New Zealand, 84 tons to Canada, 202 tons to "other Commonwealth countries," 99 tons to Eire, 45 tons to Sweden, 160 tons to Western Germany, 61 to the Netherlands, 112 tons to Belgium, 58 tons to France, 16 to Italy and 353 tons to "other foreign countries.

* * *

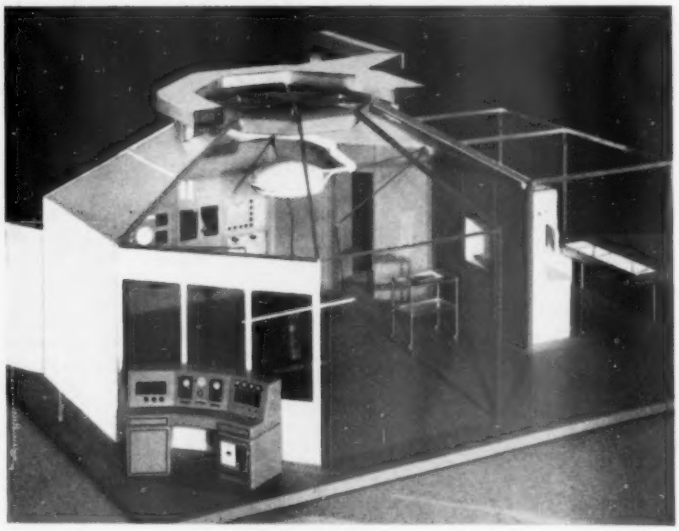
Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigeration machinery during May, commercial refrigerating machinery accounted for 216 tons worth £115,345, industrial plant and equipment for 290 tons worth £183,805, and refrigerating machinery, equipment and parts for 602 tons worth £409,055.

* * *

Exports of Small Refrigerators.—During May, 1,129 tons of complete refrigerators and domestic refrigeration equipment were sent overseas from Great Britain. These exports were worth £666,085. The 1,129 tons comprised 9 tons to the Union of South Africa, 7 tons to Rhodesia and Nyasaland, 23 to New Zealand, 178 tons to Canada, 362 to "other Commonwealth countries and Eire," 64 tons to Sweden, 51 tons to Western Germany, 20 tons to Italy and 415 tons to "other foreign countries."

* * *

"Lord Nelson" Trawler.—"M.R." inspected this month the new stern-trawler *Lord Nelson*, described as the "commercial prototype" of the marine freezer as opposed to the factory trawler. A full description will appear in August.



The modular operating theatre, seen for the first time at The Hospital Exhibition in London, achieves the highest standards demanded by the latest surgical techniques. It achieves (i) Air filtering to .001 micron; (ii) Complete change of air 20 times/hr.; (iii) Accurate control of temperature and humidity to give the best possible safeguard against bacteriological multiplication, consistent with comfort conditions for the surgical team. It is made by New Electronic Products Ltd.

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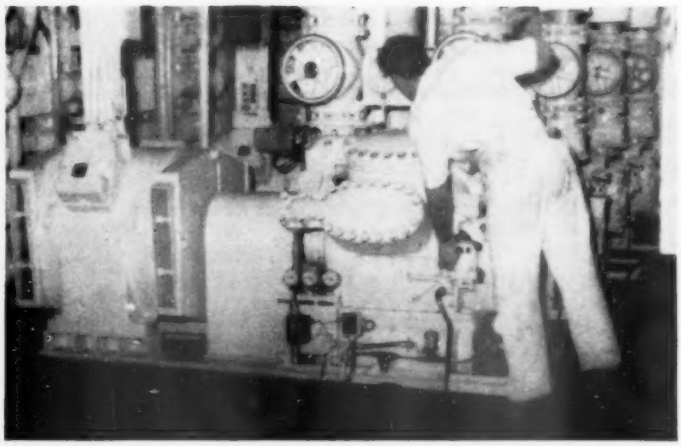


Clean as a new pin is the refrigerating engine-room in the new "Canberra"; this ship is fully described on pages 702-707 of this issue. In this picture are seen four Hall's Veebloc compressors operating on Refrigerant-12.

THE INSTITUTE OF MARINE ENGINEERS

The **Institute of Marine Engineers** announce that the following dates have been agreed for the Institute's annual meeting and functions during the 1961–2 session :—Annual conversaziones, Friday, December 1 and Friday, December 15, 1961, at Grosvenor House; annual dinner, Friday, March 9, 1962, at Grosvenor House, annual general meeting, Tuesday, April 17, 1962, at the Institute, Guild House Charity Ball, Friday, April 27, 1962, at Grosvenor House. In addition, the Institute is organizing an International conference for Marine Engineers in London from May 7 to 12, 1962.

* * *

Food Science Congress.—The 1st International Congress of Food Science and Technology will be held in the Imperial College of Science and Technology in London from September 18 to 21, 1962. The programme has been planned on a broad and comprehensive basis with a view to attracting the fullest possible attendance from food scientists and food technologists throughout the world. The congress will also provide an opportunity to form, if desired, a governing body for planning future international congress and other international activities. The programme is divided into four sections, which will run concurrently throughout the four days of the congress except for a number of periods devoted to plenary sessions and congress symposia. Details can be obtained from the Honorary Secretary, 14, Belgrave Square, London, S.W.1.

* * *

Storage of Serum.—The Commonwealth Serum Laboratory, Parkville, Victoria is now using Onazote for the storage of serum in six prefabricated rooms varying in size from 12 ft. by 8 ft. by 9 ft. to 50 ft. by 16 ft. by 9 ft. These are insulated with 3 in. of expanded ebonite, faced with aluminium.

* * *

Ammonium Nitrate Plant.—Nitrogen products made at a new Fisons factory to be built near the Esso refinery at Milford Haven will be transported by special rail and road tanker fleets to Fisons compound fertilizer factories. Ammonium nitrate will be manufactured from synthetic ammonia to be produced at an adjacent plant owned jointly by Fisons and Esso. Fisons' similar factory at Stanford-le-Hope, Essex, obtains ammonia from the adjacent Shell refinery at Shellhaven.

Liqui-Flash Freezing.—Liqui-flash freezing is a process whereby a product can be frozen very quickly and very economically in a liquid. The liqui-flash freezer employs the principle of liquid distribution that breaks through the freezing barrier. Many small streams of freezing solution raining down on the product remove the heat much faster than if the product was completely submerged in the freezing solution or in an air blast. For more than eight years the Gordon Johnson Company engineers have carried out heat transfer experiments in order to develop a practical heat transfer system for use in the poultry processing industry. The freezing agent is activated propylene glycol. This is an edible solution and is approved for use in frozen food products. Propylene glycol is used extensively in the pharmaceutical, cosmetic and food industry. It is used in the production of flavour essences and colouring in food processing, it is used as a solvent for drugs and medicinals in the pharmaceutical field, and used in the manufacture of creams, lipsticks, skin tonic, tooth paste, and soap in the cosmetic industry. There are two circulation systems in the new freezing unit.

REFRIGERATION FOLLIES —No. 5

★

"If madam had been to Interplas, madam would have realized that ice produced in polystyrene trays is not only colder and more colourless but it even tastes less."

PROSPECT FOR FREEZE-DRYING

Increasing interest in this method of food preservation in the U.S.A prompts this reappraisal of its merits by a special correspondent.

THE PRINCIPLES of freeze-drying have been known for over 25 years, and even before the war reliable freeze-dryers of all sizes and types were available. The product does not require refrigerated storage, and if dried to a low moisture content will keep for a year or more with unimpaired quality. When reconstituted with hot water, freeze-dried foods have, according to some claims, the full colour, size, shape and flavour of the original, being superior to canned and sometimes even frozen foods.

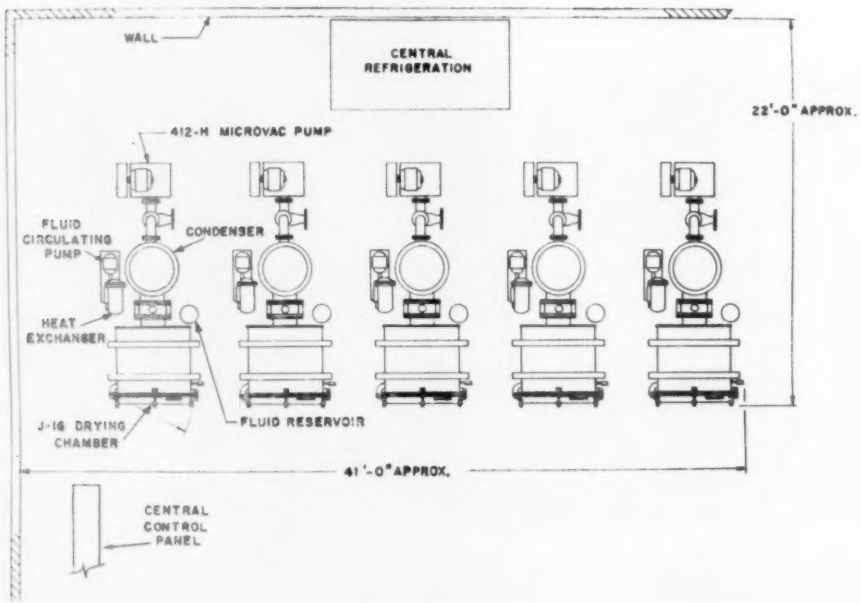
Trials of freeze-dried foods by mountaineers, lone voyagers, and the like are commonly in the news, and the results generally demonstrate the utility of this method of preservation. There is currently an upsurge of interest in freeze-drying in the U.S.A., though as yet, compared to the usage of other means of preservation, the output of freeze-dried foods is infinitesimal. It is possible that the climate is now right for the method to be used on a large scale; this can best be decided by an examination of the process, and of the experience of others in this field. The merits of the process can then be argued, and its future prospects assessed.

The Process

The foods are first frozen, and are then dehydrated under high vacuum; in this way, the moisture is removed by the direct sublimation of ice crystals into vapour, leaving the structure of the food intact, and avoiding heat damage. The resulting cellular structure contains about 98 per cent. solids, and reconstitutes in hot water in 10 to 15 minutes. A can containing 13½ oz. of freeze-dried shrimp provides 5 lb. of the reconstituted product with, it is claimed, no detectable difference in flavour, taste or aroma.

For a shelf-life of a year, it is necessary to reduce the moisture content to not more than 2 per cent., and this may take 13 hours; for a shelf-life of 2 to 3 months, a moisture content of 5 per cent. can be tolerated, and the processing time can be cut to less than five hours. Vacuum requirements in the dryer are stringent—the pressure must be less than the vapour pressure of water over ice, about 1 mm of mercury at 0°F. and 4.6 mm at 32°F. The optimum drying rate begins at about 1 mm, and most freeze-drying is in fact carried out at 0.1 to 1.5 mm.

Uniform heat transfer to the product is necessary



Proposed freeze - drying plant. Two - ton/day capacity.

to provide even drying, and hence to avoid local tough spots or a tendency to crumble. The process is lengthy because of the poor thermal conductivity of the porous structure. The food is normally spread in flat trays, and the trays are placed on the plates of the freeze-dryer; a heating medium circulates through the hollow plates, and the food is dried by heat conduction from below and radiation from the bottom of the plate above. Electrical heating is used in some pilot plants but dielectric heating, which at first sight seems ideally suitable, has so far not been proved practicable. Compression of the product between the heating plates improves the thermal contact and reduces the drying time, though this method has not found favour with U.S. equipment manufacturers.

There are clearly a number of competing factors in the drying process: cost, quality and structure of the product, the characteristics of the food and its required ultimate moisture content, and hence shelf-life. If cost is not the prime consideration, several factors can be varied to improve the quality of the product. Thus, careful variation of the temperature of the heating medium during the drying cycle, starting perhaps as low as below 32°F. and concluding at 280°F., gives a final product of superior quality. Again, reduction of the drying time may not necessarily lead to savings in processing costs; overnight drying may be conveniently operated by normal day labour, whereas three-shift working would be required to take advantage of a much shorter drying time.

Typical Equipment

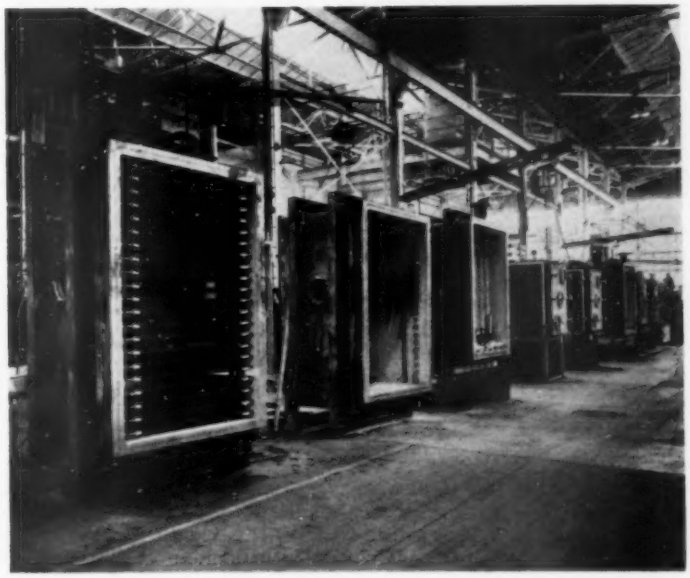
One of the leading equipment suppliers in the U.S.A. is the F. J. Stokes Corporation, of Philadelphia 20, Pa., who were early pioneers in this field. This and a few other manufacturers offer test facilities for the evaluation of foods for freeze-drying suitability. Stokes produce freeze-drying cabinets with from 10 to 17 shelves, each standard-size shelf of 60 by 44 inches holding about 55 lb. of foodstuff at a loading of 3 lb. per sq. ft. The shelves are heated by water at 175°F., steam or other fluid, and the vacuum is produced by steam ejectors or mechanical vacuum pumps. Equipment is available for production rates of from 1 to 100 tons a day; typical multi-cabinet systems now being installed cost from £40,000 to over £100,000. A recent Stokes installation is at the Albion, New York, plant of Thomas J. Lipton, Inc., where chicken and mushroom are freeze-dried for use in soup mixes.

A Danish firm, A/S Atlas, of Copenhagen, produces equipment in which drying is accelerated by a pressure of 8 to 10 lb. per sq. in., this being built up gradually from zero during the drying cycle; the pressure is applied through layers of expanded metal above and below the food, this method also providing means for the vapours from the food to escape. The drying time for fish fillets 1-inch thick by this method is 8 hours, compared to 16 to 20 hours by normal means. Armour & Co. is operating three Atlas units, one in Aberdeen and two in Illinois.

Continuous freeze-drying offers many attractions for the large food manufacturer, and equipment of this type is under development in Britain—by Vickers-Armstrongs Ltd., of Swindon—and in America and Germany. The problems of providing efficient air-locks for the entry and removal of the product from the vacuum are clearly immense, but the continuous method seems to offer considerable advantages in principle, as opposed to batch operation with its relatively high capital cost in relation to output.

Present Use of Freeze-Drying

Besides the operations of Armour & Co. and of Liptons already mentioned, a few examples of other



Freeze-drying units being produced in an American factory.

users may be given. The Liana Company, of San Carlos, Texas, processes shrimp by this method, and freeze-dried meats are being test-marketed by Wilson & Company Inc., of Omaha; the latter company has for the past two years prepared precooked freeze-dried beef and chicken in polythene bags for campers, with encouraging results. Other firms who are either in production or are still investigating the process include H. J. Heinz Company; Campbell Soup Company; Libby, McNeill & Libby; and Stokely-Van Camp, Inc. A company in Montclair, New Jersey, called Wagerized Food Products, Inc., has licensed several food processors to use its "Wagerizing" method of freeze-drying, as used by the Liana Company for shrimp. One of the licensees, the Goren Packing Company, Inc., of East Boston, Mass., has spent £180,000 on a plant extension of 30,000 sq. ft. to freeze-dry steaks in various forms; these items are at present frozen, so that only one further processing step is involved. The company believes that freeze-drying should open up new marketing channels; and in the supermarkets, where freezer space may already be full, non-frozen freeze-dried items could more readily find display space.

The U.S. Army has played a major role in the development of interest in freeze-drying, both by the research carried out by its Quartermaster Food & Container Institute at Chicago, sometimes in co-operation with commercial firms, and as a buyer of freeze-dried foods in large quantities. These foods can sustain troops in widely dispersed units—an important factor in the event of nuclear warfare. The great reduction in weight produced by freeze-drying is also a key factor. The Food & Container Institute is said to have come up with a "bulging" menu, including such delicacies as shrimp creole and meat balls, for evaluation by the troops. A conference in September last year sponsored by the Institute drew an unexpectedly large attendance for a two-day meeting on freeze-drying. The Army's aim is clearly to stimulate the establishment of civilian freeze-drying capacity which will be available in case of national emergency, a further example of food preservation methods developing from military requirements. Other governments are, of course, interested in the process, including the Canadian Government and the British Ministry of Agriculture, Fisheries and Food.

FULL AIR-CONDITIONING OF NEW LONDON OFFICE BLOCK

TINTAGEL HOUSE, Albert Embankment, London, is one of the few multi-storey office blocks in London to have full air-conditioning to all floors. It is also the first building in this country in which Velovent induction units have been used.

It was designed by the Architects T. P. Bennett & Son for South Bank Estates Ltd. Ellis (Kensington) Ltd., were responsible for designing and installing the air-conditioning, heating, plumbing, drainage and fire services, and York Shipley Ltd., were employed as sub-contractors for the supply and installation of the water chilling plant. The main contractors for the project were F. G. Minter Limited.

For the purpose of air-conditioning, the building has been divided into two zones, each separately controlled by an outside compensator fitted on the external wall. These compensators actuate the zone water plants which consist of calorifiers, mixing valves and pumps and which, in turn, circulate either hot or chilled water to the Velovent induction units fitted beneath each window. The design conditions are as follows:—

Summer—Outside: 85°F. Inside: 75°F.

Winter—Outside: 30°F. Inside: 68°F.

The Velovent units have a capacity equivalent to approximately 37 c.ft. of air per minute per person. The main air plant serving these units is situated on the roof of the building and is capable of handling 40,000 c.ft. of air per minute. The plant consists of Rollomatic filter, air washer, heaters and coolers and two multi-vane centrifugal fans, each handling 20,000 c.f.m. In the event of one fan being shut down, partial treatment can still be given to the building. Space provision has been made for an electrostatic precipitator should this be found desirable at a later date.

Chilled water is provided at a temperature of approximately 43.5°F. from the refrigeration plant supplied and installed by York Shipley Ltd., North Circular Road, London, N.W.2. This plant, which is fully automatic, comprises a 260 h.p. York package water cooling system and includes an 8-cylinder $6\frac{3}{4}$ in. by 5 in. V/W Refrigerant-22 compressor, 22 in. by 12 ft. shell and tube condenser and 30 in. by 12 ft. shell and tube water cooler. A Heenan and Froude cooling tower, situated on the roof, is connected to the refrigeration set by large galvanized pipes.

Heating is by four boilers manufactured by Hartley & Sugden to their "Oilex" pattern. Three are rated at 2,200,000 B.t.u. per hour, with one boiler for summer use rated at 495,000 B.t.u. per hour. Each is fired by Pillinger oil burners. Hot water from these and chilled water from the refrigeration plant is connected to the zone water plants and to the heating and cooling batteries in the main air plant, and supply from each service is automatically adjusted according to needs.

Air is supplied at medium velocity from the main

air plant on the roof by way of six main vertical shafts, each fitted with sound attenuators. One air shaft is located at each end of the building supplying the Velovent units on the end walls of the building. The four remaining shafts descend towards the centre of the building and connect with horizontal ducts which run for the length of the building at ceiling level on each floor in a void over the central corridor. From these ducts branches are run in the floor thickness to serve the Velovent units under windows on the floor above.

Ducting used on this contract is spiral wound and is insulated with glass silk and, when not built into the structure, is clad with aluminium with riveted and taped joints. The extract installation consists of a centrifugal fan mounted in the roof plant room which draws vitiated air from the main vertical duct which, in turn, collects from the void over each corridor on each floor. A small extract adjustable register is provided at high level opposite each Velovent unit. The centrifugal extract fan is capable of dealing with 30,000 c.f.m., and generally, 25 per cent. of this quantity is re-circulated through the system.

The Velovent induction units are manufactured under licence in this country by Air Control Installations Ltd., each unit being provided with individual finger-tip control in order to allow the office occupant to obtain conditions suitable to his requirements. Incorporated on the control panel to each unit are two primary air buttons which allow the office occupant to shut off the primary air from the main air plant on the roof should he desire, the Velovent unit then acts as an ordinary convector heater.

The majority of the toilets are fitted with opening windows, but grilles have also been provided for spillage of conditioned air from the offices. A mechanical extract installation incorporating duplicate centrifugal fans is fitted. Domestic hot water is provided to the toilets from calorifiers situated in the basement boiler house, these calorifiers being served by the heating boilers in the winter and by the small boiler in the summer.

Thermoelectric Water Cooler

A NEW type of home and office water cooler, working on the thermoelectric principle, has recently been placed in production by Westinghouse Electric Corporation's major appliance division.

By using principles of thermoelectricity, engineers have eliminated the traditional compressor and refrigerant used in conventional refrigerating devices. Except for the fan at the bottom used to dissipate the heat drawn from the cooling elements, there are no moving parts to the thermoelectric cooling system. Compared with the conventional cooler, the new model which otherwise resembles its conventional counterpart, occupies 25 per cent. less space.

The new water cooler is claimed to be the first home appliance using the principle of thermoelectricity to be manufactured on a production line basis in the United States.

Bottled water coolers are designed for use in areas where potable drinking water is in short supply. An estimated 1,000,000 American homes depend on bottled water for drinking purposes. The new bottle-type cooler will be produced in grey for office use, and white for home applications. The 36-in cabinet height of the conventional water cooler was retained because it places the water tap at a convenient level.

The new cooler occupies 25 per cent. less space than the conventional cooler.

Westinghouse has been actively engaged in thermoelectric studies for some 30 years but only recently has the corporation uncovered materials which can be used efficiently enough to permit practical applications, such as in the thermoelectric water cooler.

Prototype thermoelectric appliances were first introduced by Westinghouse two years ago. These included a dehumidifier, refrigerator, baby bottle "cooler-warmer," mobile hostess cart with refrigeration and oven compartments, and electroluminescent lighting panels which can heat, cool or light a room.

British Refrigeration Plant Impresses Russians

By E. M. M. LUKE

ONE of the largest fairs ever staged by British Industry overseas took place in Moscow from May 19 to June 4. A total of 725 companies participated and spent some £2,000,000 in presenting an all-British display of mainly capital goods for which there is an obvious market in Russia.

After the official opening of the fair by the Right Honourable Reginald Maudling, M.P., president of the Board of Trade, the platform party headed by Mr. Kruschev toured the exhibition and expressed interest in all that they saw.

The fair, which was held under the joint sponsorship of the Association of British Chambers of Commerce and the All-Union Chambers of Commerce of the U.S.S.R., was organized by Industrial and Trade Fairs Limited. Although the Board of Trade was an important exhibitor, the fair was not subsidized nor underwritten by the Government or the sponsors. In the light of this, the enthusiasm of the exhibiting companies reflected the enterprise and initiative of at least a section of British industry which is alive to the necessity of finding new markets for its products.

The exhibition was open 12 hours a day seven days a week, and for the 17 days of the fair over 1,000,000 visitors clicked through the turnstiles. More than 103 technical films were shown on stands and in addition the general cinema, run by "Pearl and Dean," had on show for nine hours a day technical and general interest films. Thirty scientific lectures were delivered by exhibitors to specially invited audiences.

More than 1,600 top sales executives and engineers, nearly one-third of them directors of their companies, had flown to Moscow for the fair and all were kept busy on their stands answering a constant stream of highly technical enquiries from the very knowledgeable Russian visitors, many of them women engineers.

The location of the fair was the Sokolniki Park of Culture and Rest, a pleasant wooded park which in recent years housed the exhibitions of the U.S.A., Czechoslovakia, and Japan. But the British Exhibition occupied a larger area than all these three put together and was by far the largest foreign fair ever held in the U.S.S.R. The fair was staged in four main halls with a number of additional open-air sites and occupied an area of about 23 acres. Although most of the stands were prefabricated in the U.K, an army

Mammoth Sterne-built, refrigerated semi-trailer seen in Red Square.

Terrific interest being shown in Sterne's stand.

The Sterne "team" at the British Trade Fair in Moscow with their two lady interpreters. Left to right, Messrs. John Elliott, Stanley Swift, Edward Elliott, Anthony Brown, William R. Houston, Charles S. McVey and Eric M. M. Luke, the author of this article.

Below: Blast-freezing and hydrocooling plant were of chief interest on the Hall-Thermotank stand.

of 400 British employees was required to erect these on the site. Full marks must go to the exhibitors for the high standard of design and finish of the stands in spite of extreme difficulties of operating in the U.S.S.R.

The Russian authorities, true to their word, sent delegations from all the appropriate buying organizations to visit the stands and representatives came from almost every communist country, including China, many of them having travelled farther to the fair than the British exhibitors themselves.

There was a small but reasonable cross-section of the refrigeration industry at the fair represented by Associated Electrical Industries, Crawley Bros., English Electric, Hall-Thermotank, Prestcold, Ranco, Sterne, Vickers, and G. Williams Engineering.

A.E.I. had a very large exhibit of some 3,500 sq. ft. which demonstrated the uses of electricity in industry, medicine, research, and the home, and included domestic refrigerators. The main exhibit was a mass spectrometer, the first using a spark source to be made commercially available and so sensitive that quantities as small as one part in 1,000,000,000 can be detected by it. Because of its value in analysing impurities in materials it was of special interest to nuclear scientists and electronic engineers and recently two were purchased by the Soviet Union.

Crawley Bros. Ltd. had on show a selection of their "Acro-Kool" iced drink dispensers for the rapid

Mr. Kruschev was extremely impressed by the quality of products on show at the British Fair, Moscow. He is seen here leaving the Pressed Steel stand where, in addition to refrigeration equipment, exhibits included items covering transport by road, rail and air.

cooling and quick service of fruit juices, iced milk, etc.

The English Electric stand was another of the larger exhibits and incorporated several of their associated companies. The principal exhibit here was power generation equipment, but the exhibit which attracted most interest from the general public was a working fitted kitchen complete with English Electric refrigerator.

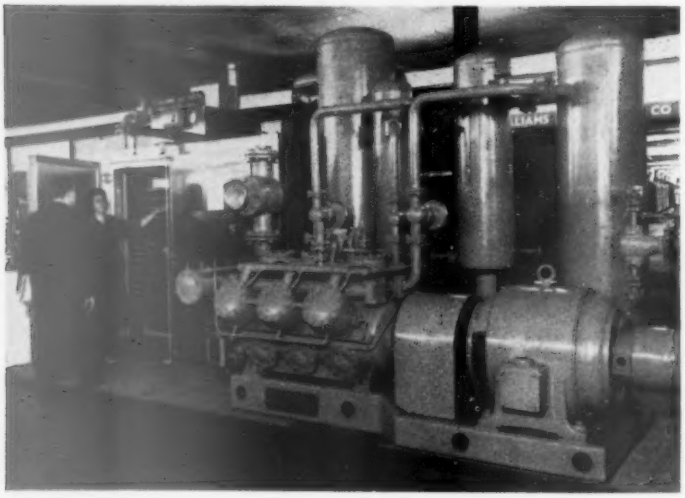
The **Hall-Thermotank** stand displayed a model blast freezer tunnel designed so that it only required two operators and fitted with automatic door operation. Other exhibits included a hydrocooler for leaf vegetables, vertical plate freezer, marine air-conditioning units, mixing box for high velocity air-conditioning systems. Particular interest was shown in the vertical plate freezer which was designed to freeze whole fish on board ship.

The " Hydrocooler," which removes field heat from fruit and vegetables, was of great interest to agricultural organizations, who have apparently not seen this technique before.

The **Pressed Steel Co. Ltd.** were mainly showing their capacity and technique for the production of car bodies, railway rolling stock, and steel-pressing tools but also included some of their refrigeration equipment. There was great interest in the small " Packaway " which is ideally suited to the many flats being built in the Soviet Union.

Ranco Ltd. found keen interest in their working display, illustrating the control systems for the new reverse-cycle defrosting. Other Ranco exhibits included a heat pump display unit, thermostats for refrigeration, air-conditioning, and heating, fractional horse-power motors, starting relays, and overload protectors. So great was the interest that at times they had to switch off working models to avoid congestions in the gangways.

L. Sterne and Co. Ltd. had on show their complete



G. Williams Engineering Co.'s freezing installation including a double-contact plate freezer fitted with "direct conduction" plates, a mechanical draught evaporative condenser and a nine-cylinder Williams-Grasso compressor, the whole with a capacity of 1 ton/hr. of fish fillets. The exhibits occasioned considerable interest and technical questions posed were often most searching. The complete installation was purchased by the Soviet authorities and will be commissioned in Moscow in September.

range of hermetically sealed Tecumseh refrigeration compressors and a sample from their heavy industrial equipment. Great interest was aroused by the Russian version of their film " Cold Comfort " which was on continuous show on the stand showing the production methods involved in the manufacture of a hermetic unit. Copies of Burns's original manuscripts on the stand were of considerable general interest to the Russians many of whom know his works well. Sterne also had on show their new refrigerated trailer which had travelled the 2,000 miles overland from Glasgow bringing with a 10-ton load of frozen meat and fish for use in the British Exhibitors' restaurants. During the fair which took place in exceptionally warm weather, grateful, perspiring exhibitors were supplied daily with ice cubes made in this vehicle.

The Vickers Group were showing principally plant for airfields, chemical works and docks and some minor refrigeration exhibits.

G. Williams Engineering Co. Ltd. featured a double-contact plate-freezing installation which could freeze foodstuffs at very high speed and found this to be of great interest to the Russians.

Few of the refrigeration companies participating were prepared to give very definite information about the success of the fair as far as they were concerned, as in many cases negotiations were under way with the various buying organizations. The general impression was almost without exception one of considerable optimism for a stake in this promising potential market of 208,000,000 Russians. Mr. Maurice Harmsworth, European manager of the Pressed Steel Company, said as he left Moscow :—

> " This fair has fully justified the effort we put into it. We came to test out the market and assess future prospects. I am sure from our experience here that the Soviet market is worth further attention. We have had enquiries from buying commissions from all over the Soviet Union and from other East European countries, *e.g.* Rumania and Hungary. We have been particularly impressed by the interest in our refrigeration equipment both domestic and commercial. We do not anticipate any sudden rush of orders. Both we and the Russians have now got to go away and digest what we have learned from each other. For our part we look forward to further meetings with them. Overall I have been astonished by the enormous attendance of both trade buyers and the general public, and by the highly intelligent questions asked about our equipment."

Within a few days of the fair opening **Hall-Thermotank** secured an order for the supply of the self-contained marine air-conditioning units they were exhibiting on their stand.

Visitors to the fair were entertained by the regimental band and the pipes and drums of the 1st Battalion, Argyll and Sutherland Highlanders, who performed twice every day. The splendid appearance of the Argyll and Sutherland Highlanders in their traditional full Highland dress delighted the huge audiences which collected as soon as they appeared. So great were these crowds that on several occasions the " beating of the retreat " had to be abandoned as the public broke through the cordons of police surrounding the display area.

For most of the British exhibitors their visit to Moscow was the first one and was a unique experience. General surprise was evident over the modern aspect of Moscow with its huge modern buildings mainly of skyscraper proportions—closer examination of these buildings revealed the Russian love of the traditional in architecture and decor. Many fine modern buildings were Edwardian in their interior decorations with extensive use of marble columns ornate woodwork and heavy drapes. The streets, like so many things in Moscow, were kept spotlessly clean, being washed down every night by high-pressure water carts. In Moscow the speed limit is 35 m.p.h., but no one appears to observe this. On the broad main streets traffic raced along 12 cars abreast in the region of 60 m.p.h. There are reputed to be 150,000 policemen in Moscow, and this could be believed, as every crossroad and pedestrian crossing had at least two " militia men," as they are called, on duty. Muscovites must be about the worst " jay walkers " in the world. The militia men's whistles could be heard blowing constantly as they corrected careless pedestrians.

Hotel accommodation in the main hotels was good, almost every bedroom having its own bathroom. Food, while not of exciting standard, was reasonable. On average an evening meal could take at least two hours. The " decadent " Western habit of tipping was prevalent in most hotels, although the absence of a tip never caused offence. Many fair exhibitors took time off from their long day to visit the sights of Moscow. Those who visited the Bolshoi Theatre, which ran a constantly varied programme of opera and ballet, were loud in their praise for the spectacular production and faultless performances. Shopping in the Russian capital was not easy as the adverse rate of exchange made most items expensive for British pockets and the standard of consumer goods was generally lower than in most European countries. On this subject, however, Mr. Kruschev made an important speech at a Government reception given for the British exhibitors. He announced that the Soviet Government now intended to allow the consumer industries to expand at the same rate as heavy industry and there is no doubt that this trend is already under way. One exhibitor remarked that he was amazed at the improvement in the Muscovites' dress since his previous visit to Moscow only 10 months before.

Many people were surprised at the apparent freedom which the Church in Russia enjoys. One exhibitor who visited a cathedral in Smolensk found that the extensive reconstruction work in hand was being paid for by the State.

A party of British refrigeration personnel toured the main Russian refrigeration plant at the Zill works in Moscow. This plant was turning out some 150,000 domestic cabinets per year. The hermetic unit incorporated was almost identical to the American General Electric Unit. Some of the current production models were old fashioned in design but prototypes of the new " square look " models due for

Continued on page 720

Accuracy and Uniformity in Calibration of Platinum Resistance Thermometers

RESISTANCE thermometers are made in three general forms: long-stem, capsule, and calorimetric. The sensing element in the long-stem and capsule types consists of a fine helix of platinum wire wound bifilarly on a supporting frame of mica. The winding is supported by notches in the mica frame in such a manner as to leave the wire as strain free as possible. Near each free end of the coil is attached an additional short platinum lead wire, making the sensing element a 4-lead resistor. The coil is protected by enclosure within a gas-filled case.

The capsule thermometer is short, about 2 in. in length, and has a platinum case. The lead wires exit through an air-tight glass seal, and the capsule is filled with a mixture of helium with 2 per cent. oxygen. As the entire capsule, including the glass seal, is at the temperature being measured, and because glass becomes significantly conducting at high temperatures, this type of resistance thermometer is not normally used above 300°C.

View of disassembled cryostat used in calibrating capsule-type resistance thermometers at very low temperatures. Both test and standard thermometers are inserted in the copper block (lower right) and this assembled unit is placed up into the metal Dewar immediately above. A second Dewar (centre) is positioned around the jacket and soldered to the plate near the top. The entire assembly is surrounded with liquid N_2. Liquid hydrogen is transferred into the inner Dewar, and the temperature is controlled over the range 10 to 90°K by a combination of pumping the hydrogen and heating the block.

The stem-type resistance thermometer is usually about 18 in. long, although the resistance coil is quite small. The short platinum leads of the resistor are attached to four gold extension wires, and the entire assembly is enclosed within a glass cylinder containing dry nitrogen and 2 per cent. oxygen. Because of the length of this device, the point where the wires exit through the case is at room temperature, and stem-type thermometers are often used to 500°C. if encased in glass and to 630.5°C. and above if enclosed in quartz.

The third type of platinum resistance thermometer, used in calorimetric measurements, has a coil wound on a flat strip of mica which is encased within a thin metal sheath. The case is filled with dry air. This type of construction has the advantage of rapid thermal response, which is an advantage for some types of calorimetric determinations.

Capsule-type resistance thermometers are calibrated at temperatures as low as 10°K. (−263°C.) but, because of the electrical conductivity of the glass at high temperature, they are usually not calibrated at the sulphur point. Thermometers of the stem-type are calibrated at the boiling points of oxygen (−182.97°C.), water, and sulphur (444.6°C.), and at the triple point of water (0.01°C.), and those of the calorimetric type are calibrated at the triple point, steam point, and near 50°C. The capsule- and stem-type thermometers are annealed before calibration by being placed in the re-entrant wells of the sulphur boiler for four hours.

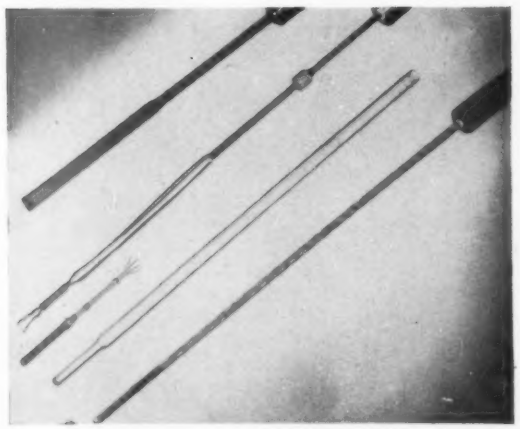
Resistance Measurement

The resistance of the thermometer being calibrated is measured with a Mueller-type bridge. Readings are taken to the nearest ten micro-ohms, with a current of two milliamperes flowing in the thermometer. In most cases, the heating effect of this current can be ignored if the thermometer is used with this same current. However, if the thermometer is to be used under conditions where the thermal contact is poor or variable, errors which might arise from the heating effect can be minimized if all (calibration and actual use) resistance readings are taken with both 2 and 5 milliamperes flowing in the thermometer, and the resistance at zero current found by extrapolation. To eliminate the resistance of the lead

wires attached to the platinum resistor, readings are made with two combinations of bridge-lead connections. The resistance of the coil alone is then the average of the two readings.

Low-Temperature Calibration

Over the range of 10 to 90°K., capsule-type resistance thermometers are calibrated in the United States in a hydrogen bath against one of the National Bureau of Standards' standard resistance thermometers. Both the test and standard thermometers are inserted into a copper block, and the necessary connexions are made. This aggregate is then placed



Basic types of platinum resistance thermometers calibrated by the U.S. National Bureau of Standards. At the upper left is a metal-encased thermometer used in calorimetry. The short capsule-type thermometer (centre) must be attached to the 4-lead assembly and inserted in the glass protection tube when it is to be positioned in a deep re-entrant well. A stem-type thermometer is shown at the bottom.

within the cryostat. The system is sealed from the atmosphere by soldering an airtight canister to the stationary cover with Woods metal. The temperature within the cryostat is controlled at temperatures below 20°K. by adjusting the pressure on the liquid hydrogen refrigerant within the cryostat. At temperatures above 20°K., the temperature is controlled by electrically heating the block to achieve the desired temperature and then heating the shield to maintain this temperature. A control system, actuated by a multiple-junction thermocouple between the copper block and the shield, maintains the temperature within narrow limits. After thermal equilibrium is achieved at each calibration temperature, several simultaneous resistance readings are taken on each thermometer and the standard.

A second cryostat is used for the calibration of both capsule- and stem-type resistance thermometers at the oxygen point (−182.97°C.). Once again, a comparison is made with a standard resistance thermometer.

Because the thermometers are inserted in a long re-entrant wells, a lead-wire assembly must be attached to capsule-type thermometers, and a glass protection tube is slipped over both the thermometer and lead wires. Liquid nitrogen is used to cool the cryostat, and a heating coil, controlled automatically as in the hydrogen bath, is used to maintain the temperature at the oxygen point. Several readings are taken for each thermometer at the oxygen point.

Triple Point Calibration

Although the triple point of water (0.01°C.) was not adopted as a defining fixed point on the International Practical Temperature Scale until 1960, the bureau has been using triple point cells in calibration activities for many years. The cell consists of a sealed glass cylinder nearly filled with pure, air-free water. A re-entrant well is provided for the insertion of a thermometer. In use, the cell is cooled by immersion in an ice bath, and a mantle of ice is formed around the re-entrant well with dry ice. After a sufficient mantle has formed it is freed from the galss by slight warming from within the well, to provide an immediately adjacent water-ice interface.

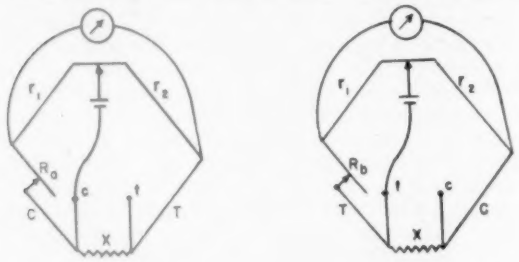
The thermometer is then inserted into the well, using an aluminium bushing for good thermal contact. Resistance readings are then taken after equilibrium is achieved. To check on the stability of a thermometer during calibration, the resistance at the triple point is determined before and after measurement at any of the other fixed points.

This high-temperature platinum resistance thermometer developed by the U.S. National Bureau of Standards has platinum wire thread through disc supports made of synthetic sapphire. Drifts as low as 0.001 degree/hour at 1,000°C have been achieved with this device.

Steam and Sulphur Point Calibration

Special boilers, operating in a closed system in which the pressure can be closely regulated, are used to reproduce the steam (100°C.) and sulphur (444.6°C.) points. Helium gas is employed to transmit the pressure to a precision manometer. The

boilers are cylindrical, with re-entrant wells extending from the top into the vapour region. The water boiler was constructed of copper, heavily tinned on the inside to prevent contamination, and the sulphur boiler was made of 2S aluminium. At the bottom of each boiler is a re-entrant dome, inside of which is placed an electric heater. Tangent to the dome, and within the boiler, are positioned vertical silver (water boiler) or aluminium (sulphur boiler) wires which prevent explosive boiling. Radiation shields are placed within the boilers to isolate the re-entrant wells from the boiler walls and heating zone. The vapours are condensed at the top of the boiler by means of water-cooled jacket. The level of the helium-vapour interface, which must be known for the determination of pressure, is measured with thermocouples placed within the walls of the condenser.



Adding the equations yields $X = \frac{R_a + R_b}{2}$

Diagram of the circuits used to eliminate the effects of lead resistance when calibrating platinum resistance thermometers. In A three of the four leads (C.c,t,T) of the thermometer are connected to the bridge, and the resistance $Ra + C = X + T$. In B the connexions have been reversed, and $Rb + T = X + C$. Adding the equation gives $X = Ra + Rb$. Thus, $\frac{Ra + Rb}{2}$ by taking readings in the two positions and averaging the results, the resistance of the sensing element alone can be determined.

The water boiler reaches thermal equilibrium quite rapidly, but experience has shown that temperature changes occur within the sulphur boiler for some time. Therefore, calibrations are not started until the sulphur has boiled for at least ten days. With each boiler, several resistance readings are taken for each thermometer after equilibrium is reachd in the re-entrant wells.

Calorimetric-Type Calibration

This is accomplished by determining the resistance at the ice and steam points, and at a third point near 50°C. A stirred water bath, in which the test thermometer is compared with a standard thermometer, is used for the latter point.

Also, the resistance of platinum wires such as are used in thermocouple construction is determined at the triple and steam points. The resistance at 0°C. is then computed, and the ratio of the resistances at zero and 100 degrees (R100/RO) is determined. This ratio must exceed 1.3920 to meet the specifications of the International Practical Temperature Scale.

Automatic Calibration Procedure

Effort is being made to put the calibration procedure on a more automatic basis. Read-out devices are being incorporated to permit automatic recording of all raw data which will facilitate communication with the computer. Plans have been made to permit the oxygen bath to be connected to the precision manometer and which will provide, directly, a defining fixed point temperature (−182.97°C.). Plans are also being made to construct an apparatus for the calibration of resistance thermometers at the zinc point (419.505°C.). This temperature, which is more reproducible than the sulphur point, has been accepted as an alternative to the sulphur point in the 1960 text of the International Practical Temperature. Scale.

The International Practical Temperature Scale of 1948, by H. F. Stimson, J. Research NBS **65A** (Phys. and Chem.). (To be published.)

Temperature, its measurement and control in science and industry, Vol. 1, pp. 141-168, (Reinhold Pub. Corp. 1941).

High temperature resistance thermometry, Tech. News Bull. NBS **43,** 233 (Dec., 1959).

Flamingo Foam Limited have developed a product known as "Flamingo foam," an insulating material which does not absorb water or water vapour. It has closed cells and so provides its own protective barriers and because of these barriers it continues to insulate at its high theoretical level, even under extreme conditions of dampness and humidity. This new insulant consists of 98 per cent. still air and 2 per cent. polystyrene. It has a snow white appearance and is extremely light. Consequently it is easy to handle, and is issued in boards from ¼ in. to 18 in. thick. These can be processed on site with ordinary woodworking tools. Other properties are : it will not rot or decay ; it is completely odourless —wet or dry ; it does not give off fumes ; it will not flake or delaminate ; it is non-irritant to the skin ; it cannot support mould growth ; it is inactive towards all foodstuffs ; it is tasteless and has no food value, and has therefore no attraction for rodents or other vermin.

MICRO H CHEMICAL FEEDER

Already widely used in America on applications involving chlorinating, defoaming, rust and scale inhibition, wash water detergents, cooling water treatment and slime control, the F.P. micro H chemical feeder is now offered in Britain by Fischer & Porter Ltd., who are assembling it in their Workington factory. This chemical feeder is designed to feed, meter and regulate very low flow rates of a chemical solution continuously into a liquid stream through its built-in ejector. By virtue of its plastics construction the instrument can be used with a very wide range of corrosive fluids. The reagent flow rate is manually set and automatically regulated.

SKI JUMPING ON ARTIFICIAL SNOW

★

UNITED CARLO GATTI, STEVENSON & SLATERS LTD., supplied the "snow ice" laid on the ski run at the International Ski Jumping competition held at Wembley Stadium last month, and organized by the Ski Club of Great Britain.

For the three performances over 150 tons of "snow ice" were produced. The ice was delivered in block from Carlo Gatti's Battersea factory and crushed into "snow ice" on site. This was achieved by the use of an American ice crushing slinger.

High speed platform hoists situated along the jump carried the snow up to various heights for spreading on the run. The lower reaches were serviced by truck barrows which tipped their loads direct on to the outrun. The grade of snow ice produced proved very satisfactory to the Norwegian advisors in charge of the competition, also to the competitors who jumped very confidently, landing on a layer over 6 in. thick.

The ski jump, constructed by Mills Scaffolding Ltd., was built of tubular scaffolding. The tower was 150 ft. high and the overall length 376 ft. This allowed for jumps of over 120 ft. Competitors from Norway, Sweden, W. Germany, Austria, Finland, Italy, Switzerland France and Great Britain took part.

Left: Side view of crushing machine, with background of scaffolding on which run was built.

Below: "Snow ice" being pumped into truck barrows for spreading on lower reaches.

The **Pyrene Co. Ltd.**, have brought out a product known as "Preperite" which covers a range of general purpose materials for the removal of rust from iron and steel and corrosion products from non-ferrous metals. Two solutions are available. "Preperite No. 1" is an uninhibited solution conforming to the Ministry of Defence Specification DEF-36, and "Preperite No. 3" is an inhibited solution which conforms to the Ministry of Defence Specification DEF-37. "Preperite" is normally applied by brush or immersion. When applied by immersion the solution may be operated cold or heated to 130° F. to speed up the operation. The same solution may be used for treating both ferrous and non-ferrous materials but for zinc and cadmium a limited treatment time is necessary. An immersion "Preperite" solution will continue in service almost indefinitely provided its strength is maintained by replenishment as required.

SHIP OF THE CENTURY

AIR-CONDITIONING AND REFRIGERATI

OF 45,270 tons gross, *Canberra* is the latest addition to the passenger fleet of P & O-Orient Lines—a fleet already consisting of 17 liners, including 10 ships of post-war construction. Many authorities have called her "the ship of the century" for she is a complete breakaway from traditional design. Until now the largest liner in this fleet has been the 42,000-ton *Oriana*, another great ship which entered service on December 3rd, 1960. *Canberra* and *Oriana* have together cost some £30 million.

This fleet of 18 liners, totalling 463,313 tons gross, is the largest passenger fleet being operated in the world.

Apart from being the most modern passenger ship in the world, *Canberra* also has the distinction of

SERVICES ABOARD *CANBERRA* DESCRIBED

being the largest passenger-carrying ship in the world—the maximum number of passengers she can carry is 2,238.

The keel of *Canberra* was laid down at the Belfast shipyards of Harland & Wolff Ltd. on September 23, 1957, and she was launched on March 16, 1960.

Mr. John West, an assistant manager of P & O-Orient Management Ltd., is the designer of the *Canberra*. He was born in August, 1927, at Hebburn-on-Tyne, Durham. He was educated at Jarrow Grammar School, Rutherford College of Technology and King's College, Durham University. He obtained final certificates in practical shipbuilding and naval architecture at the City and Guilds London Institute at the age of eighteen and holds an honours degree (B.Sc.) in naval architecture. Mr. West's early

training commenced at the shipyard of Hawthorn, Leslie and Company Limited, at Hebburn-on-Tyne, after which he studied shipbuilding in France as a foreign exchange student in 1948. He joined the P & O Company in September 1952 as assistant naval architect and was promoted assistant to the management and technical adviser in January 1956. John West stood by the building of the cargo liners *Pa'onga*, *Ballarat* and *Bendigo*, worked on the designs of *Salsette* and *Salmara* and on more recent additions of the P & O cargo fleet, and developed the early designs for tankers—a new departure for the P & O group of companies.

Canberra is a twin-screw turbo-electrically propelled passenger and cargo liner built under Lloyd's Register and M.O.T. Survey for P & O-Orient Lines, the principal dimensions being:—

Above: Bonito Club 1st-class pool.

Left: The Peacock Room is designed for quiet sitting, smoking and reading and has two adjoining cardrooms for the more serious players.

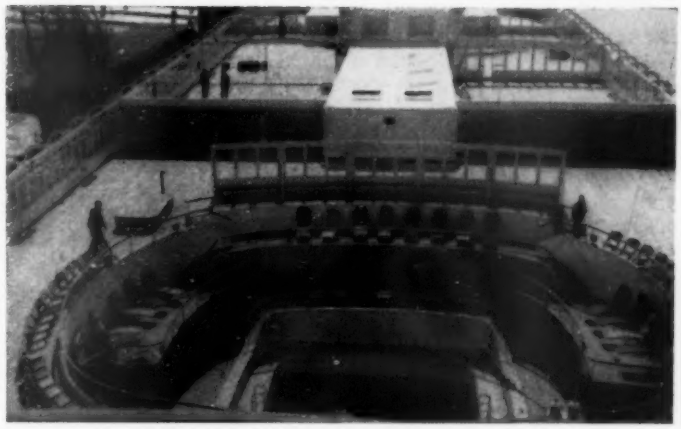
Below: Air-conditioned de-luxe cabin.

Length overall, about	820 ft.
Length B.P.	740 ft.
Breadth moulded	102 ft.
Depth moulded	41 ft. 6 in. to "E" Deck
Gross tonnage	45,270

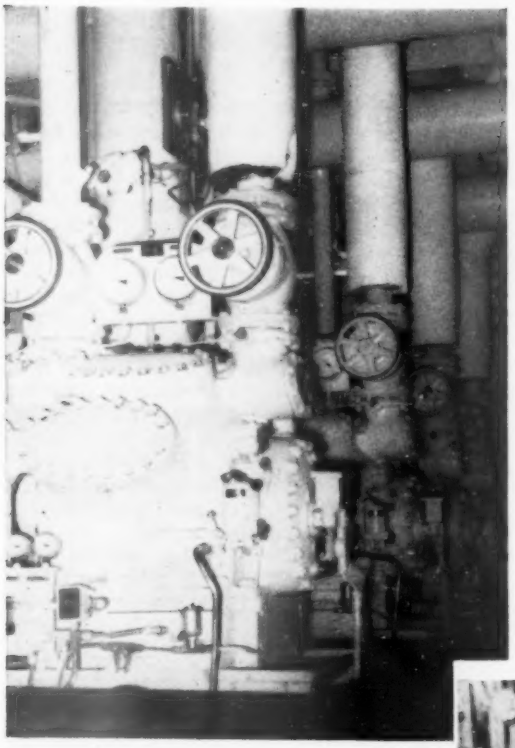
The finely modelled hull has a curved rounded stem, the underwater portion of which is of bulbous form to give the most economical performance at service speeds, and a modern cruiser stern. The final form was arrived at after an extensive series of tank tests at Messrs. Dennys and at the National Physical Laboratory. The machinery spaces are located towards the after end of the vessel in order to give the greatest possible comfort to passengers. Separate compartments are allocated to generator room, engine room, propulsion room and boiler room.

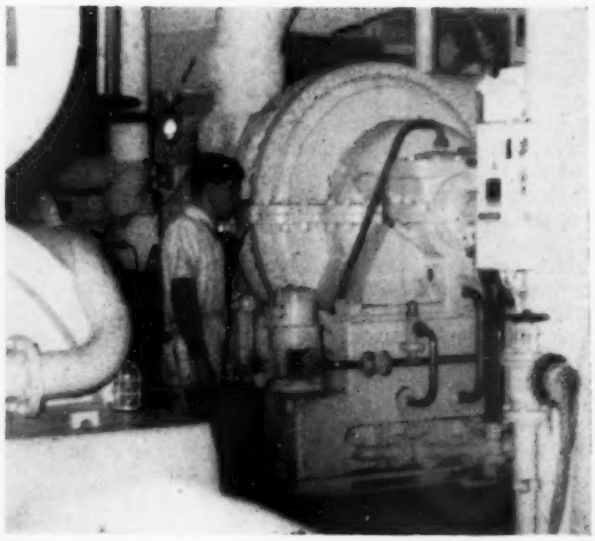
The hull is divided into 16 main com-

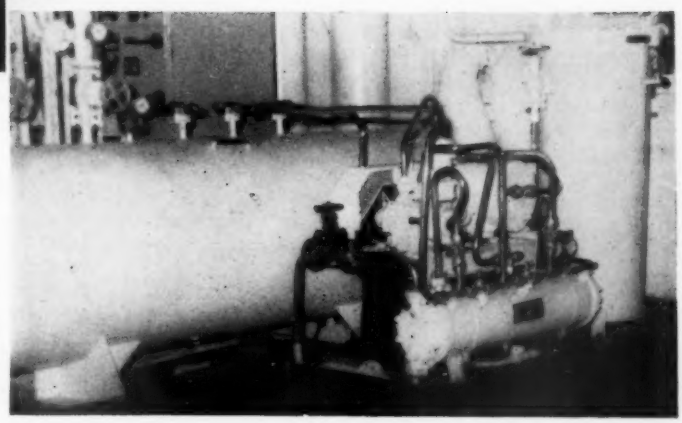
View showing first-class pool and vast area of sports deck space.



partments by 15 watertight divisional bulkheads extending to "E" deck. The tanks for oil fuel, water ballast and fresh water are arranged in the continuous double bottom and in the fore and aft peaks. Deep tanks are also provided forward of and below no. 1 cargo hold. The deep oil fuel tanks are arranged forward of the machinery space. Nos. 1, 2 and 3 holds and lower 'tween decks are arranged for cargo, with special lock-up compartments in No. 1 'tween decks. In addition, nos. 2 and 3 holds and 'tween decks are also fitted out to carry 50/100 cars, depending on size.







Above: Four 8-cylinder Hall machines on provisions duty. Middle right: One of four centrifugal compressors on air-conditioning. Right: Independent Hallmark unit on low temperature storage

A bullion room and refrigerated space for carrying serums, etc., are provided.

Accommodation has been arranged for 548 1st class passengers and 1,590 tourist class passengers, with an additional area of interchangeable accommodation which increases the above figures to 598 1st class or 1,690 tourist class, as may be required.

Considerable thought has been given to the layout and design of the passenger cabins in both classes to ensure maximum comfort. In the 1st class accommodation a special feature has been the introduction of "court" cabins, the entrance alleyways serving these cabins being so designed that each inboard cabin is fitted with a window to give a view along the "court."

A large galley and pantry area, equipped with modern electrical cooking appliances, etc., is centrally situated for serving 1st and tourist class restaurants. The equipment includes electric ovens, grills, fryers, bakers' oven, hotpresses, salamanders, hotplates, toasters, etc., and a large number of domestic machines such as potato peelers, dough mixers and dish-washing machines. Ample refrigerated and dry store rooms are conveniently arranged on the decks below the galley. Service pantries have been arranged on all decks for serving morning tea and light snacks, also buffet service to open decks. Bars have been positioned to serve all public rooms.

The baggage handling equipment has been designed to load or unload baggage for 2,200 persons in approximately two hours. A special item of the baggage handling equipment is the "Vertiveyor" which enables baggage loaded at any particular deck to be discharged automatically at any other preselected deck. The specially designed cargo handling equipment includes two electric cargo transporters, by means of which cars or cargo can be lifted from the quayside, transported through shipside doors and discharged into nos. 2 and 3 'tween decks or hold as required. Derrick posts and derricks with electric winches are provided for dealing with cargo at no. 1 hatch.

Air Conditioning System

Canberra's air-conditioning system is one of the largest marine installations ever designed. The total length of air ducts on the ship is 17.25 miles and the air quantity handled by the fans is equivalent to 50,000 tons of air per day—5,000 tons more than the weight of the ship itself.

The air-conditioning system, which was designed, manufactured and installed by Thermotank Ltd., Helen Street, Glasgow, is served by 70 central conditioning units.

In these units the air is filtered, heated or cooled according to outside conditions, and its humidity adjusted to a comfortable level before being distributed to cabins, public rooms and other accommodation throughout the ship.

The system provides individual control of the temperature of the conditioned air by means of reheaters.

The Reheater

In 1st class officers' and engineers' cabins these reheaters are in the branch ducts serving the accommodation. A bulkhead indicator in the cabin itself governs the operation of a thermostat, which in turn actuates the valve controlling the supply of warm water to the reheater.

If the passenger sets his indicator to maximum cooling, the valve shuts off the supply of warm water and the conditioned air enters the cabin at the lowest temperature which the system provides.

The thermostat

If, however, the passenger later changes the setting of the cabin indicator, the thermostat is brought into operation, allowing the valve to supply warm water to the reheater and thus raising the temperature of the air to suit the passenger's own preference.

The air-conditioning units serving the tourist and crew accommodation are fitted with reheaters which operate, for groups of accommodation they serve in the same way as the individual cabin reheaters already described, except, of course, that the zone thermostats function automatically as a group control.

The pressurestat

The quantity of air entering this accommodation can be controlled to suit individual requirements and automatic pressure controllers ensure that the pressure in the system is maintained at the correct level, irrespective of the fluctuating demands created by passengers operating their individual volume controls.

When heating is required, a calorifier—fitted in association with the refrigerating machinery—supplies warm brine to the air-conditioning units, which then function as preheaters. The final temperature control is again governed by the reheaters.

The temperature of the warm water supplied to these reheaters is controlled in accordance with outside conditions. In the tropics, for instance, the water temperature will be moderate. In a cold climate, however, the water temperature will be high enough to maintain interior conditions of 70°F. when the atmospheric temperature is well below freezing point.

When heating is required, automatic humidifier valves come into operation at each air-conditioning unit.

To passengers in *Canberra*, the only visible evidence of the air-conditioning system will be a perforated panel on the cabin ceiling. In fact, Thermotank's "Sofflo" distributor, which was developed specially for *Canberra*, houses not only the automatic sprinkler but also the Tannoy loudspeaker.

Foamed Insulation

The branch trunk carrying conditioned air from one of the ship's 70 central air-conditioning units leads into a small reheater, which is integrally insulated by expanded polyurethane foamed *in situ*. The reheater is exceptionally light and compact and is fully protected by the rigid insulation. Its operation is governed by a thermostatically-controlled valve. The setting of the thermostat can be altered to suit the passenger's own preference by a simple movement of a bulkhead control.

Draughtless

After passing through the reheater, the conditioned air is delivered to the "Sofflo" distributor through "Flexflyte" flexible ducting.

The "Sofflo" distributor then diffuses the conditioned air into the cabin in a draughtless pattern which induces immediate and thorough mixing with the room air.

The distributor fits flush with the ceiling and, where necessary, accommodates the automatic sprinkler and the Tannoy system loudspeaker. "Sofflo" distributors have been designed in a range of sizes to suit the varying requirements of the spaces served.

Noiseless

As will be seen from the photograph, these distributors had to be accommodated in very shallow ceiling voids and this posed many problems in achieving efficient diffusion of the conditioned air at the unusually low noise level required.

In the public rooms in *Canberra* the conditioned air is introduced through "Stripline" grilles. These are continuous strip diffusers which fit flush to the bulkhead and, since they are very unobtrusive, they blend readily into the decorative scheme. "Stripline" grilles function by continually projecting, through a series of elongated slots, a thin blanket of air over the room.

J. & E. Hall Limited were responsible for the refrigerating machinery which comprises four 2-stage centrifugal compressors operating on Refrigerant-11, each directly coupled to a single-stage steam turbine of 547 BHP; four 8-cylinder veebloc compressors directly coupled to electric motors of 100 BHP; also various Hallmark units.

The centrifugal compressors deal with the air-conditioning duties, each set being capable of abstracting 5.5 million Btu/hr. Speed regulation enables the output to be controlled to give a smaller duty when the vessel is in temperate waters. Below this duty the air-conditioning demand will, in general, be handled by the standby compressor forming part of the provision chamber machinery.

Four 100 BHP. eight-cylinder machines operating on Refrigerant-12 deal with 19 independently cooled provision chambers having a total insulated capacity of 88,000 c.ft. Three of the compressors are capable of performing the holding duty and arrangements are made so that compressors may be allocated to air-conditioning duty when the vessel is in temperate waters with a limited number of passengers on board.

Cooling in all provision chambers is effected by means of plain pipe air cooling batteries with air circulating fans, air coolers being arranged for brine circulation.

In addition to these duties the plant provides cold brine for about 40 cold cupboards in way of galleys, saloons and pantries. Seven drinking water coolers of capacities ranging from 100 to 300 gallons are fitted on various decks; these also are cooled by brine from the main plant.

Three special brine cooled cabinets have been fitted in service counters in the confectioner's shop, tourist cold pantry and fruit and salad room, all situated on "E" deck.

Seventeen automatic cocktail icemakers are fitted in, or adjacent to, various bars and pantries. These units produce about 96,000 ice cubes (3,715 lb.) per 24-hour day.

Ten independent Hallmark units are fitted for working in conjunction with beer and mineral lockers and draught beer cabinets.

Four water coolers of 30 to 200 gallons capacity are fitted with independent Hallmark water-cooled condensing units. A 6 HP. water-cooled unit is fitted in the dairy to maintain the required temperature in the ice cream hardening room which has a capacity of about 410 c.ft. Hallmark units also work in conjunction with 5½ gallon Giusti ice cream freezers.

One Hallmark flake icemaking machine is fitted in the locker by the fish preparing room.

In the café pantry on the arena deck one 17 c.ft. domestic automatic refrigerator cabinet is fitted. Twenty-seven Electrolux refrigerator cabinets of various sizes are sited throughout the ship.

FROM FAR AND WIDE

G. J. Coles, Australian chain store operators with about 250 stores, are using Onazote in prefabricated freezers and chillers, each 10ft. by 10 ft. by 8 ft., insulated with 5 in. and 3 in. thickness of Onazote respectively. The order was placed through Explastics Insulations Pty., Ltd., Expanded Rubber Company's Australian agents.

* * *

Birds Eye Foods Ltd., are to expand their Scottish storage facilities to meet expanding demands for their products. Their Refrew store will be expanded to hold 10 times its present volume by the end of August. The Edinburgh store will be increased by six times capacity and the Dundee store by three times. Both the Edinburgh and Dundee expansions were due to be ready at the end of June. They have also increased the number of refrigerated vehicles serving the Scottish area. These developments are linked with the steady expansion of frozen food trading in Scotland following a period of caution on the part of retailers and consumers.

* * *

In describing American air-conditioning for aircraft, we stated that the Hamilton system was the first air-conditioning system that uses the aircraft's own fuel supply for cooling. In point of fact, the de Havilland Aircraft Co. Ltd. flew an airborne refrigeration system which used fuel as the main cooling medium as early as 1958 ; this system was described in the paper read before the Institute of Refrigeration in April 1960. This was the first refrigeration system embodying this feature to be flown in Europe and, quite probably, this applies to the U.S.A.

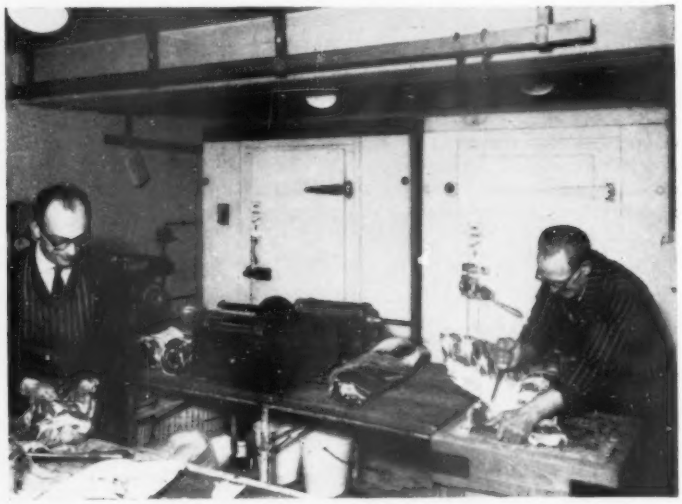
SHOP REFRIGERATION NEWS

AN INTERESTING COLD ROOM INSTALLATION

By Our Special Correspondent

DOES Mr. Clarence Turnbull, I wonder, hold the record for a butcher's area of cold storage space in relation to selling area? A customer of H. C. Troldahl Ltd., Frigidaire distributors for the counties of Northumberland and Durham and for the North Riding of Yorkshire for 23 years, he has no fewer than seven cold rooms operating on his premises. In a retail shop of little more than average size, at 340 High Road, Gateshead-on-Tyne, he has a total cold storage area of 2,245 c.ft.

The first cold room was installed in 1938. This, still in completely efficient use, has a capacity of 125 c.ft. The use to which it was put from the beginning is shown by the first illustration. All the joints are



An early installation of Turnbull's in Gateshead-on-Tyne.

Two more cold room installations at Turnbull's.

cut the previous day and kept in cool condition in readiness for the rush of week-end trading.

It was another 10 years, including the war period, before another cold room was added. This one, installed in 1948, was of 160 c.ft. capacity. Another was installed in 1952. By this time Mr. Turnbull was beginning to realize the tremendous advantage of cold room space as a means to the end of buying in larger bulk, with its consequently more favourable prices.

Two more cold rooms followed quickly (of 185 c.ft. and 175 c.ft., respectively) in 1953, and four years later, space was found for a cold room that was nearly twice the size of all the others put together (1,325 c.ft.).

And last year, to this total of 2,095 c.ft., another addition of 150 c.ft. of cold storage space was added.

Not only does Mr. Turnbull get more favourable terms for buying in large quantities: he is also saved the trouble of going to market. He does all his ordering by telephone.

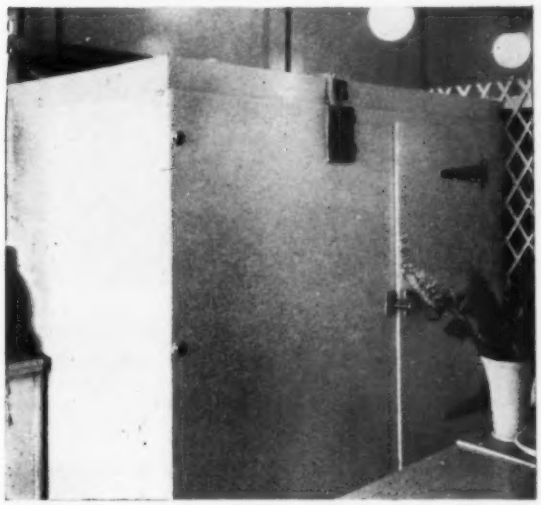
He is also able to give quick service in the shop, to have always a very wide choice of joints and small cuts for customers' selection, and have a large proportion of the meat ready-wrapped.

The pre-packaging for the week-end trade is carried out on the premises; two men are engaged on the cutting up, wrapping, sealing, and price-marking all day long on Thursdays and Fridays each week.

It is gratifying to record that the number of greengrocers using refrigerated display equipment for fresh produce—though there are still very few of them—is slowly increasing. Most of this progressive few use refrigerated cabinets inside the shop: refrigerated windows are quite rare, although it now seems a reasonable hope that the greengrocer will, within the next 10 years, come to make this method of presenting his more perishable merchandise as much a matter of course as do the butcher and fishmonger to-day.

I came across one of these rare examples in the shop of Mr. and Mrs. B. Ninnim, on a housing estate at Cove, near Farnborough in Kent. The base of the left-hand window of this shop is a Winget Cooltop, installed by Seldon & Co. Ltd. The sloping marble base is covered by removable grilles which allow air to circulate beneath the green vegetables and salads displayed.

This shop is also fitted with a double-length Smithfridge-McCray cabinet for quick-frozen foods.



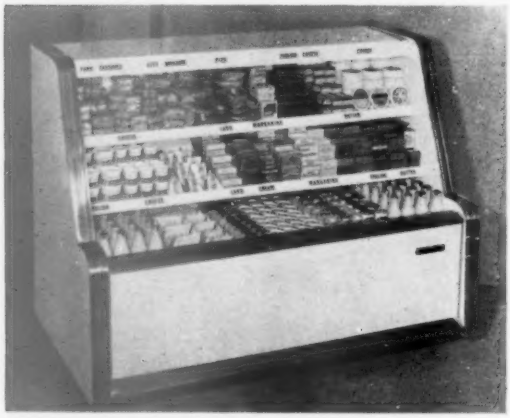
Great Activity in Scottish Food Trade

THE Scottish trade is currently very active on the industrial side with substantial order books, particularly for retail trade purposes. This is a result of the gradual build-up of modernization of retail units, replacement of older fittings as a result of obsolescence and the impact of the Clean Food Code. For all these reasons the fitting out of shops has been going ahead steadily.

The big multiples and the co-operatives have been

in the van of this work and continue to give a solid volume of business each month. The independents have also been coming into the picture on an increasing scale and are now refitting at a steady rate. This activity on the commercial side has been particularly satisfactory in view of the slackness on the domestic side. Scottish customers have been slow to react to promotional schemes in this aspect, just as they have been slow to accept frozen foods in the way that England did. But there are welcome signs that the Scots are now changing their attitude in so far as frozen foods are concerned and that increased offtake can be expected of these foods. One Scottish firm, Craig-Nicol Ltd. of Glasgow, reports that a current demand for frozen food cabinets is running at about 100 per cent. above last year. Majority of owners are now reaching the point where they are scrapping their "down the well" enclosed smaller cabinets which were installed in the earlier days of this trade and are replacing them with larger glass fronted units. There is even a trend towards 8 ft. models which is a substantial improvement on earlier thinking in this field.

Craig-Nicol also reported a satisfactory situation on the commercial refrigeration side, with facilities fully extended to cope with the pressure of business.



FRIGIDAIRE'S THREE-TIER DISPLAY CASE

A new self-service display case, refrigerated on three tiers, has just been introduced by **Frigidaire** as an addition to the Talisman range of display cases first introduced in 1960. Designed for the refrigerated display of cooked meat, provisions and dairy produce at temperatures of 38° to 42° F. or 42° to 48° F., the Talisman three-tier case provides an exceptionally large display area within the same dimensions of floor space as a single-tier case. This is achieved by displaying goods on raised shelves.

Refrigeration is by forced air convection over all three tiers, the coolers being connected to a Frigidaire condensing unit installed remotely. Defrosting is carried out automatically.

Levin Refrigeration have brought out a new double-decker quick-frozen food cabinet, the " Frys-O-Matic 227/F," which is of all-welded cantilevered sheet steel construction; this it is claimed, makes the cabinet rigid, sturdy and hygienic. The outer shell is a high quality cold-rolled steel-sheet body, phosphatized against corrosion and finished in high-baked synthetic glossy enamel. The border above the front glass is made of polished stainless steel. The tubular legs of the cabinet are adjustable, allowing correction in case of uneven floors.

The inner shell of sheet aluminium is finished in white enamel. Both shelves are provided with fluorescent illumination, the upper one with a sloping mirror. The cabinet has a special evaporator coil with a large effective refrigeration area designed for low temperatures. Fans force the thermostatically controlled air to circulate around the goods. An electric timer controls the automatic defrosting, which is effected by means of heat rods built into the evaporator coil. A suitable refrigeration unit, with a control system for all-automatic operation, is delivered for remote installation. The cabinet is 8 ft. 10¼ in. long, 3 ft. 3¼ in. wide, and 4 ft. 11 in. high; this handsome new cabinet has a display area of 34 sq. ft.

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

FULL-TIME COURSES IN REFRIGERATION 1961-62

ENROLMENT for the full-time courses in refrigeration at the National College for Heating, Ventilating, Refrigeration and Fan Engineering, Borough Polytechnic, Borough Road, London, S.E.1, is now in progress. Applications should be submitted without delay to the clerk of the governors of the college, from whom forms of application and syllabus booklets may be obtained. The courses commence on September 25, 1961, and end on July 6, 1962.

Institute members will remember that these courses were established in order to meet the needs of the industry by providing the necessary specialized educational facilities in refrigeration and allied subjects. The supply of trained refrigerating engineers in the future depends on full use being made of these facilities and it is, therefore, sincerely hoped that those members of the Institute concerned with staff training will release as many suitably qualified younger members of their staffs as possible for the period of the course. The advantages which will ultimately accrue to the industry by firms being farsighted enough to release young men to attend these National College courses, at a stage when they most readily absorb knowledge, will be obvious to those with the interests of the industry at heart. The fees for the courses are very moderate and, in many cases, may be covered by grants or scholarships.

Diploma Courses in Refrigeration

The diploma courses are primarily intended for apprentices who have obtained a pass at the A.I. stage of the higher national certificate in mechanical engineering. (It is essential that the ordinary national certificate should include applied heat or heat engines in the examination year or have been taken as an endorsement.) The majority of students have this background and are released by their employers for the diploma course. Applications for admission to the diploma courses will also be considered from students with other qualifications if these are equivalent to the A.I. stage of the higher national certificate in mechanical engineering.

The British Refrigeration Association which, like the Institute, has representatives on the board of governors of the College actively co-operates with the college in assisting and encouraging member firms to release students to attend the college.

In certain cases, students attending diploma courses may obtain Government or county council grants and scholarships towards fees and maintenance during the necessary period.

Associateship Courses

The course of study laid down for candidates for the associateship of the college consists partly of advanced instruction in one of the three technologies catered for at the College and partly of training in research. About half of the available time is allocated to research, which may take the form of theoretical or experimental studies or the development of new designs. The candidate is expected to submit a thesis describing his researches which should show his ability to contribute to new knowledge. He will also be required to show satisfactory progress in his class work.

Fees

The college fees for both the diploma and the associateship courses, applicable to United Kingdom residents, are £52 2s. per annum.

College Hostel

An additional facility available is the National College hostel at Dulwich. Accommodation is provided at moderate charges and applications for residence should be made at the same time as enrolment for the course.

Syllabuses

Full details of the subjects covered are given in the college syllabus booklet, referred to above.

CRYOGENICS

The strenuous efforts which are being made in many quarters to arouse and stimulate interest in the practical implications of "cryogenics" as a new and rapidly evolving field of technology found expression in a paper presented by Mr. M. Zvegintzov of the National Research Development Corporation before the Low Temperature Group of the Institute of Physics and the Physical Society recently. The region of cold where such gases as oxygen and nitrogen are liquid is well known and need not be considered here. So the field of Very Low Temperature Engineering is defined as in the temperature range of just above 20°K. downwards, i.e. when all gases except hydrogen and helium are solid and where ultimately hydrogen is likewise. Below 4°K. various entirely new properties of materials and new physical phenomena appear. The production, maintenance and employment of these temperatures and the equipment, materials and phenomena associated with them, consequently give rise to new and radically different problems, techniques and possibilities.

In recent years, progress in low temperature research throughout the world has been so rapid, that "cryogenics" can now be regarded as no longer the study of low temperatures as such but both as a technology in its own right and an increasingly powerful new tool for several existing branches of technology. Under very special sets of physical conditions where peculiar conductivity, electrical and magnetic phenomena occur and properties of materials may change profoundly.

British research—at universities and public establishments—in this field is on a large scale and of outstanding quality, leading the world in some respects. By contrast, industrial engineering resources to back the above—which should have been growing *pari passu*—are almost totally lacking. Yet the chances of ultimate success will depend on scientific knowledge, technological skill and creative imagination of a very high order, and not just on *ad hoc* approaches and methods.

Liquid hydrogen is an ideal "conventional" fuel for rocket motors, whether for burning, or via a nuclear reactor. It might also perhaps be used as jet fuel or a boost for supersonic aircraft. Liquid helium is required for such rapidly widening and novel uses as nuclear particle detection, electronics, computers, properties of materials, intense magnetic fields, free radicals, and utra-high vacua. Much of the equipment has to be very small yet accurate and highly efficient, adapted for radically novel properties over a narrow temperature band—thus requiring an entirely new branch of precision engineering.

A.S.H.R.A.E'S 68th "ANNUAL"

The 68th annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) was held June 26 to 28 at the Denver Hilton Hotel, Denver, Colorado. The ASHRAE meeting programme featured a series of three technical sessions, for symposia, fora and committee meetings. Among the 15 papers just presented at the technical sessions were those on "Steam vacuum refrigeration"; "Heat and mass transfer in dehumidifying coils"; "Fluid flow through flexible orifices"; "Degradation of mylar film exposed to water and alcohol"; "Refrigerating capacity and performance data for various refrigerants," Areotropes and mixtures"; "Graphical solution for flows in hydraulic circuits"; "Sofar heat gains through domed skylights"; "Evaluation procedure for odour-control methods"; and "Infiltration through revolving doors." The symposia covered industrial ventilation, food refrigeration, air conditioning, and domestic refrigerator engineering. Victor J. Johnson of the National Bureau of Standards, Boulder, Colorado, and a member of ASHRAE's Rocky Mountain chapter, was general chairman of the host committee, assisted by chapter members, ASHRAE officers and staff.

Pros and Cons of Freeze-Drying

The advantages of freeze-drying are the ease of storage and the reduced weight of the product, and in some cases the the superior flavour. The usefulness of these products to armed forces, and to explorers, mountaineers and the like cannot be disputed.

To warrant extensive commercial production, however, freeze-dried foods must sell in quantity to the ordinary housewife and catering establishment. Several factors arise for consideration—cost, prejudice, packaging, and flavour.

Cost. This item is normally discussed in U.S. literature in terms of cents per pound weight of moisture removed; this includes the capital cost of equipment, spread over 10 years, plus labour, power and heating. For standard drying cabinets of the type illustrated, a figure of 4 to 5 cents is quoted but for improved equipment and techniques, 2½ to 3½ cents is forecast. Savings in transport and refrigerated storage can be offset against processing costs; in the case of the shrimp processed by the Liana Company in Texas, a net saving is achieved—the delivered cost in Chicago is $1.28 per reconstituted pound, compared to $1.40 for the frozen product. Cost factors are clearly less significant when the value of the dry solids in the original food is high in relation to the processing cost.

Prejudice. Dried and dehydrated foods are difficult to sell, partly because of the association with austerity, and partly because of their unattractive appearance. The public is accustomed to canned and frozen foods, which when turned out of the package, look like the picture on the label; little delight can be taken in a comestible which, as purchased, has the consistency of a dry, brittle sponge.

Future Outlook

A technological breakthrough that will reduce freeze-drying costs and improve flavour can still be hoped for, in view of the wide-spread interest in the process, though the basic ground must have been covered fairly well in the past 25 years. Present cost factors might well be radically altered by the perfection of a continuous process.

Possibly the key to the problem will be found by the advertising men, rather than by the technologists. A big potential market might be found to exist among people in the "great out-doors"—in caravans, under canvas, on the hills and by the roadside. American success in this field may well be a pointer for the future. A further possibility, which does not seem to have been explored, is in weaning foods for babies, where reconstitution would be considerably more convenient than the heating up of little tins, or of tiny amounts in a saucepan; no copywriter in the blessed state would fail for words on this.

COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and Distributors' News

Mr. E. M. Heap, joint managing director of York Shipley Limited, refrigeration engineers of North Circular Road, London, N.W.2, has been appointed to the board of Le Froid Industriel Brissonneau-York S.A. of Paris.

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Mr. T. F. W. Jackson, chairman of **Union Carbide Ltd.** announces that Mr. J. F. Widman, director and general manager, Chemicals Division of Union Carbide Ltd., will shortly be taking up a new assignment with Union Carbide International Company and consequently will be retiring from the board of Union Carbide Ltd. Mr. K. D. Rutter has been appointed marketing manager, Chemicals Division of Union Carbide Ltd.

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Lec Refrigeration Ltd., have recently opened a northern depot at Roker Park Estate, Gould Street, Oldham, Lancs. Mr. W. Pickup, the Lec northern supervisor, will be in charge of this new project and the depot will serve Lancashire and Yorkshire. Deliveries from this depot in the immediate future will be limited to a radius of approximately 100 miles, but as stocks and transport become available they will operate farther afield until the whole northern part of the country, including Scotland, is covered. The aim of this new depot is to give distributors in the north quicker deliveries.

* * *

Dewhurst & Partner Ltd. of Hounslow announce the appointment of R. A. Nisbet, Esq., A.M.I.E.E., as regional manager (south). Mr. Nisbet has been with the company for 17 years and was formerly group controller for the southern region.

The **Drayton Regulator & Instrument Co. Ltd.** announce that, as from June 1, 1961, the name of the company has been changed to **Drayton Controls Ltd.** The telephone number remains as before, viz. West Drayton 4012, but the telegraphic address is altered to Draycon West Drayton Telex.

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The **Instrument Co. Ltd.** announce the appointment of **Mr. K. J. Bush,** A.M.I.E.E., as assistant sales manager, Mechanical Thermometer Division, Friern Park, N. Finchley. The appointments are also announced of **Mr. W. C. Orford, Mr. S. V. J. Crump** and **Mr. W. A. Hall** as assistant resident engineers at the company's branch offices in Nottingham, Bristol and Manchester respectively.

* * *

English Electric have reduced the price of their 2·7 c.ft. " slimline junior " refrigerator by six guineas. The selling price of this model is now 42 guineas—£37 5s. 8d. plus £6 16s. 4d. purchase tax. The " slimline junior " has over 6 sq. ft. of shelf area inside its external dimensions of 32 in. high and 19 in. wide. It can be built-in or fits comfortably underneath a working top. Outside the " junior " is white or cream, or there is a choice of five colours, with an interior colour scheme of alpine lilac and clover ice.

* * *

Cambridge Instrument Co. have issued an eight page publication (list 25/1) describing their vapour pressure thermometers. Details of standard instruments are provided and information is also given on a wide variety of modifications and accessories which may be supplied to suit individual applications and processes. Cambridge V.P. thermometers are made with either 6 in. or 4 in. dials, calibrated to cover a variety of ranges within the limits −20° C. to +340° C. (−10° F. to +650° F.). They have a sensitivity equal to that of high-grade mercury-in-glass thermometers and the makers guarantee an accuracy of within 1 per cent of their range. Electrical contacts for alarm or control purposes may be fitted.

* * *

H. C. Troldahl Ltd., Frigidaire distributors in the four northern counties, have just opened new head offices and showrooms at Scotswood Road, Newcastle upon Tyne, on the site of their old premises opened 25 years ago. Troldahl's have had the Frigidaire franchise since 1935. They are amongst the first local businesses to erect new buildings in this area of the City which is being developed as a principal business centre. The Lord Mayor of Newcastle, Mrs. Gladys Robson, J.P., the Sheriff of the County, and other important guests representative of many trades and professions in the City were present at the opening. Mr. Troldahl presented a cheque to the Lord Mayor for the King George Jubilee Trust—a charity for the children of Newcastle, in which she is particularly interested.

The new building, which provides a central home for the company, has large showrooms on the ground floor to display the range of Frigidaire commercial refrigeration and air-conditioning products and domestic appliances. The appliances also have a special display in a new demonstration kitchen. On the first floor is the board room and executives' offices, with general offices occupying the top floor, where there is also a well-equipped kitchen and rest room for the staff.

Sales staff for the Northumberland and North Durham areas are also accommodated in the new offices. The other areas are administered from the company's branches at Middlesbrough, Cockermouth, Keswick and Barrow-in-Furness. There is also a motor service station and garage at Gateshead, from which day and night refrigeration service is operated, and a repair depot on the Team Valley Trading Estate, Gateshead.

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Westagate's have two new frozen food cabinets. The " Cruiser " and " Carrier " maintain a temperature of 0° F. to plus 5° F. at load line under normal conditions. The exterior is zinc coated steel stove enamelled in gleaming white and fitted with stainless steel trims and formica front panels. The interior is of zinc coated steel with refrigerated divider plates. The " Cruiser " has five compartments and the

The sales conference of Levin Refrigeration in London was rounded off with a delightful dinner at the Carlton Tower, Belgravia. Mr. Hugo Henriz (centre, right) presided and all the company's U.K. distributors were seated round a large circular table.

"Carrier" seven. There is 4 in. insulation throughout. The dimensions of the "Cruiser" are 51 in. by 29½ in. by 36 in. high plus 4 in. at rear for illuminated superstructure, and of the "Carrier" 72 in. by 29½ in. by 36 in. high plus 4 in. for illuminated superstructure.

Their cabinet, the "Delite," has a timber framework with hard baked white enamelled aluminium interior and exterior and stainless steel trims to ends. There are two insulated sliding doors which are easily removable and give access to the full width of cabinet. The display panel is dual glazed sealed, hermetically sealed with stainless steel surround. Two rows of plastic covered wire shelves, timber slatted grids to floor, interior sign, fluorescent light and louvred drip tray are supplied as standard fittings. The refrigeration system is 1/6 h.p. hermetic unit with finned coil and capillary, line fully sealed and warranted for five years. This model is available in lengths from 4 ft. to 10 ft. inclusive, and can be supplied in a choice of colours.

* * *

The "Aqua Clear," manufactured by the Tank and Filter Division of Tobacco Machine Supply Company, Inc. in the United States is now being distributed in this country by N. Janssen & Co. Ltd. It is an aerated tank in which restaurants can preserve lobster and trout. It claims to prolong lobster life, freshness and reduce weight loss, to eliminate the need for frequent water changes, and to most closely duplicate actual ocean water. The tank is completely transparent, and is set on four swivel casters for complete movement; the size is 28 in. by 59 in. It has an automatically controlled refrigeration unit which keeps the continuous supply of water cool and clear.

* * *

Nine refrigerators are to be won in a national competition featuring Blue Band margarine being organized in grocers' stores throughout the country. The competition which started in the middle of June closes on August 18, 1961. Attractively designed four-colour counter display units are available for all grocers. These point of sale attractions feature the special refrigerators — Frigidaire Sheerlook, Electrolux L.40 and Prestcold Packaway. The counter-piece also shows packets of Blue Band together with the competition entry form. Housewives are asked to list qualities of Blue Band in order of importance to them and complete the sentence describing why they like using Blue Band. Each entry form has to be accompanied by the top of a Blue Band packet. The present Blue Band advertising campaign is endorsed by the four large refrigerator manufacturers, namely, Electrolux, Frigidaire, Prestcold and Hotpoint. They back the fact that Blue Band spreads taken straight from the refrigerator. This is a sales point which is finding great favour with the increasing number of refrigerator owners in this country.

Mr. D. F. A. Mathias—formerly of the Mond Nickel Co. and Mitcham Foods, Ltd.—has been appointed executive director of **Jablo Plastics Industries Ltd.** Mr. Mathias has also been appointed secretary of the group of Jablo companies. Mr. Bruno Jablonsky, managing director,

is now able to devote more time to co-operation with the new associate companies, particularly to the subsidiary company in Malta and the one in Ireland which is in the course of formation.

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TEDDINGTON OUTING

Employees of the Teddington Group of companies and their guests enjoyed an outing to Brighton this year, given by the parent board directors. Over 900 people left Sunbury by special train to arrive in Brighton at 10.40 a.m. Refreshments were available on the journey and it was already a festive party which dispersed until midday to reassemble at the Corn Exchange for lunch.

Lunch was presided over by Mr. W. E. Lambourn, M.B.E., M.M., a

director of the parent company (British Thermostat Company Ltd.) who thanked everyone for their efforts over the past year. Other directors present were Mr. E. Ower, Mr. U. G. A. Tonge, Mr. S. S. Sherlock, Mr. G. T. Mills, Mr. R. H. Seward and Mr. P. Cranham.

NEW PRESIDENT OF W.I.C.F.

Mr. J. D. O. Knowles, chairman of **T. Wall & Sons (Ice Cream) Ltd.,** has just been elected president of the Wholesale Ice Cream Federation in this country. He now co-ordinates the activities of about 4,000 full-time and 2,000 seasonal employees throughout the country, who function in many varied activities, some of them highly specialised.

He will be ultimately responsible for the smooth operation of the three Wall's ice cream factories, one in London at Acton, one at Gloucester and a third at Edinburgh. There are also two wafer factories, one at Balham and one at Gloucester, and over 100 depots situated throughout Britain.

His knowledge of Wall's has been accumulated over a period of 24 years. He joined Unilever in 1937 as a young trainee and was assigned at once to Wall's Ice Cream. He was educated first at Harrow, then Heidelburg University where he read languages. Following graduation, he worked in various capacities for the Liverpool Cotton Exchange ; for a time this meant sorting different grades of cotton. Then he was sent to South America, where his language training was put to good use. It was after his return to Britain that he joined Unilever.

After serving in the war Mr. Knowles returned to Wall's and for a time worked as deputy director. Then he became director of both the meat and ice cream companies, which were managed as one (T. Wall & Sons, Ltd.) until 1955. Following the division into two independent companies Mr. Knowles took over as head of the ice cream company.

ATTWOOD TECHNICAL SERVICES APPOINT CHIEF EXECUTIVE

The first appointment announced by **Attwood Technical Services Ltd.,** the new British company formed to undertake economic research throughout the world, is that of Mr. D. H. McNeile, 38, who has joined as chief executive. Mr. Neile has been with the United Kingdom Atomic Energy Authority for the past two years, the last 12 months of which he spent in the commercial branch. Previously he was for eight years with the Iraq Petroleum Co. Ltd., including one year as secretary of the management committee. Before that he was for three years with Richard Costain Ltd., in Iran. He has a first class honours degree in the Mechanical Sciences Tripos (Cambridge). He is also an Associate Member of the Institution of Civil Engineers and Associate Fellow of the Institute of Petroleum.

THE SOFT ICE MAN COMETH

An important development in the sale and distribution of ice cream in the past two years has been the advent of the mobile ice cream factory. The first batch of 60 mobile factories of the latest type are now leaving the shops of **Bonallack & Sons, Ltd.,** the body builders, of Nevendon Works, Basildon, Essex. An order of such proportions lends itself to jig building, a method which has the advantages of speeding fabrication, cutting cost and facilitating repair problems following accidental damage.

The Commer mobile ice cream factories are of composite construction with hardwood framing and aluminium sheet exterior panelling. Front and rear domes and the rear vertical corners are moulded in glass fibre, and flooring of the main compartment is in block board, with steel in the reat compartment which carries the generator. Main compartment dimensions are : length 7 ft. 11 in. wideth, 6 ft. 2 in., height 5 ft. 9¾ in.

Large glazed areas occupy the body sides, with sills on the near side low enough for the majority buying public—small children—to watch the mixing operation and take delivery of the product. The twin freezer by Carpigiani, of Bologna, is mounted on the near side at the rear of the cab bulkhead. A second bulkhead in front of the generator compartment carries a deep freeze, cold storage cabinet and hot washing facilities. Lighting is by fluorescent tubes.

Prestcold dual compressor plant is carried below floor level on the offside. The Onan generator is driven by a four-cylinder T.V.O. engine, exhausting through the roof at the rear.

All the vehicles in the fleet are one-man operated. At the end of the day's journey, the mobile ice-cream factory returns to base, where interior and exterior are meticulously washed and routine maintenance carried out on plant and vehicle by the depot staff. The driver is primarily a salesman and is not regarded as a mechanic.

Ice Cream Equipments, Ltd., and Electrofreeze, two of the largest operators, foresee a big extension of their business in the near future, based on a rapidly expanding market and the suitability of the Commer-Bonallack mobile factory.

Ernest Scragg & Sons Ltd., of Macclesfield, manufacturers of machinery for the processing of man-made fibres, have purchased a 1 h.p. Chrysler Airtemp room unit designed to operate on the reverse cycle principle, enabling it to heat or cool as required. The unit will be used in a mobile display and office which the company installs at many overseas fairs and exhibitions at which it shows its products.

The method of operation is based upon the utilization of the heat that is normally dissipated to the atmosphere through the condenser. The reverse cycle is achieved by reversing the flow of refrigerant around the circuit. The unit consists of an air-to-air plant for conditioning a single undivided space. At the far end of the unit is an inner heat exchanger over which the air in the space is circulated by a fan, and at the rear end of the unit, which has a depth of 18 in., is the outer heat exchanger with another fan. A duct between the two fan circuits can be opened to introduce fresh air. The refrigerant, " Freon 22," delivered by the pump passes to the solenoid valve, in the front of the unit, and is directed to whichever heat exchanger is to be heated. It passes from condenser to evaporator through a long capillary that imposes a pressure drop, and from the air cooler arrives again at the solenoid valve and is directed to the pump suction. The valve, like the compressor, is completely sealed and only electric leads pass through the envelope. These leads are embedded in " fusite " glass seals. The coefficient of performance of this Airtemp unit ranges between six and seven. The plant is controlled not only by a thermostat but also when used as a cooler only, b a humidity monitor.

THE 49th NATIONAL BUSINESS EFFICIENCY EXHIBITION

Olympia—3rd to 11th October, 1961

The opening day of the 49th National Business Efficiency Exhibition, October 2, 1961, will be reserved for members of the Press, broadcasting and news film companies and those on an invitation list. The innovation is due to a compelling demand from those who wish to record and examine the exhibits more thoroughly for a closer look.

At last year's " Business Efficiency Exhibition " representatives from 60 countries were present and enquiries from overseas, coming in daily, clearly indicate that these figures will be comfortably exceeded.

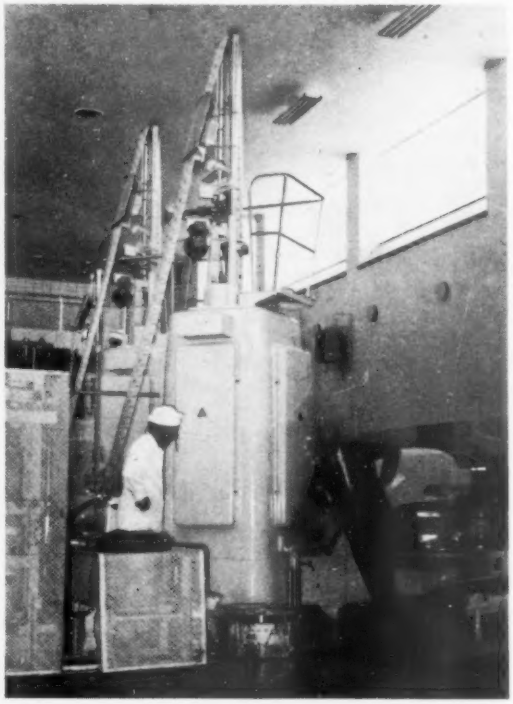
The organizers hope that the preview facility will be justified by wider interest and comment, written and spoken, on the products of an industry that has set up new records of manufacture and export each year since the war. In 1959 exports were a record which beat all previous efforts by a more than comfortable margin ; yet in 1960 the returns were again up by no less than 25 per cent. —this compared with the overall national figure of an increase of 6 per cent.

" SUPERSEAL " STRAPPING TAPE DISPENSER

An improved hand dispenser (model HDA) is being marketed by **P. P. Payne & Sons Ltd.** Of the " pull and tear " variety, the dispenser ensures rapid and accurate dispensing, cutting and positioning. Furthermore, it is small and compact so that it can be carried easily on the job by the packer. The construction of the dispenser provides the packer with a perfect grip, and simplifies the application of pressure sensitive tapes, ensuring perfect control during the sealing operation.

A special feature is the easily replaceable cutter blade, which for safety reasons has been designed to cut tough strapping tapes, without being razor sharp.

Though it can be used with all pressure sensitive tapes on 3 in. centre cores from ½ in. to 1 in. wide, and up to 8 in. diameter rolls, it is ideal for dispensing Payne's " superseal strapping tape," manufactured from high tenacity rayon threads bonded together to form a weftless tape, backed with a high tack latex adhesive. It is intended for heavy-duty packaging where its high breaking strength can be used to advantage. Superseal does not require moistening before application.



SWEDISH MILK CENTRE

The first-ever picture to be taken of the Tetra-Pak machines in the new Milk Centre, Norrköping, Sweden. This is probably the finest milk processing station in the world.

—"M.R." photo

OBITUARY

William Herbert Apthorpe, M.I.E.E.

It is with deep regret that we announce the death of **Mr. W. H. Apthorpe,** deputy chairman and former managing director of **Cambridge Instrument Co. Ltd.** He died suddenly at his home in Pyrford, Surrey, at the age of 75.

Mr. Apthorpe's service with the company began in 1900 at a workshop bench in the Cambridge factory. In 1907 he resigned, but returned in 1911 after serving as assistant to Professor Donnon at Liverpool University, where he was able to continue his technical education. He became assistant works manager at Cambridge in 1915.

In 1919, the company purchased the Muswell Hill business of R. W. Paul, and Mr. Apthorpe went from Cambridge to become works manager at the new factory. He was appointed to the board of directors in 1925, subsequently serving as director of production, joint managing director, managing director and deputy chairman.

In over 50 years' service with the company " W.H.A." was concerned in the development of many instruments, including the Duddell oscillograph and the Galitzin seismograph. He was particularly interested in electrocardiographic equipment and helped to develop the two string galvanometer used in early outfits. He was a pioneer in the field of automatic temperature control and his work later resulted in the development of the Apthorpe regulator, which was one of the earliest forms of controller to use a pivoted galvanometer.

Mr. Apthorpe was always keenly interested in the welfare of employees and was a member of the central committee of the employees benefit fund for 20 years. He was chairman of the committee from 1955 until his death. His knowledge and experience will be greatly missed by his colleagues and friends.

The South Western Electricity Board recently ran a Refrigeration Fair fortnight at several centres, when sales, despite unfavourable weather, came up to expectations. These are views of the Taunton showrooms.

COMMERCIAL AND INDUSTRIAL

A new product "tubefile" has been developed by **General Precision Systems Ltd.** This is a versatile automatic flame-cutting machine for producing profiles on steel tubes which are required to saddle other tubes. It was designed and developed to meet the requirements of the structural steel industry for a machine which would profile quickly and accurately the ends of steel tubes which have to be saddled and welded to other steel tubes. The design permits its use also in profiling of steel pipes used in the chemical and petroleum refining industry. Present methods of preparation of tubes generally require production of a template giving development of the profile. Apart from the considerable drawing effort involved, the processes of template making, marking out, flame cutting using hand held equipment, and finally, trimming, are expensive and time consuming. Using "tubefile" the normal preparatory processes are eliminated. From a simple drawing giving centre-line information profiles can be cut on each tube using only unskilled labour. Multiple profiles as a result of common intersection of several tubes can also be produced.

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A cabinet, entirely new in design, for the refrigerated display of fish, cooked meat, etc., the "Rotosell", has been brought on to the market by the makers of the Regal range of insulated products. It is a revolving display cabinet, completely self-contained, with the whole of its two display decks within the plate glass protecting screen, revolving at a speed sufficient to catch the eye, yet slow enough to enable sales to be made without stopping the machine. It has an overall diameter of 6 ft., a height of 2 ft. 3 in. on the lower deck and of 2 ft. 10 in. on the upper deck. The height over the lighting canopy is 5 ft. 6 in. and to the top of the glass screen, 3 in. The cabinet has two sloping decks of vitrolite, coiled underneath with ½ in copper tubing, and insulated. These decks are supported on a steel and timber construction which also carries the compressor, motor and electrical gear. Decks and compressor revolve at approximately two revolutions per minute. The lighting canopy on top of the central column carries thre 100 watt. lamps. The approximate temperatures obtainable are 36° to 40° F. on each of the decks.

New rotary display cabinet.

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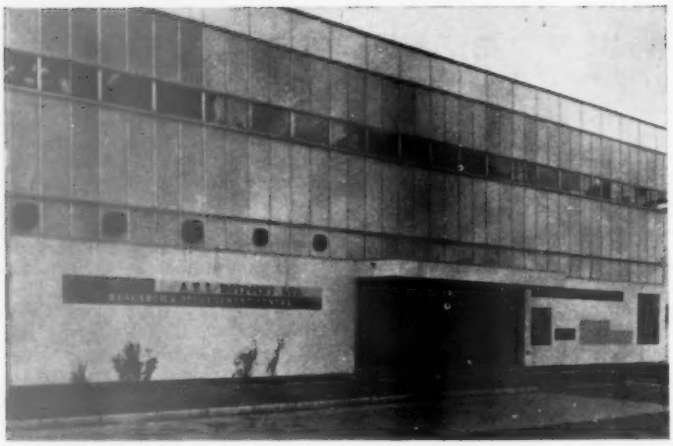


HOTPOINT RESEARCH

Another important stage in their expansion programme has just been completed by A.E.I.-Hotpoint Ltd. at a cost of a £250,000. Their new research and development centre at Peterborough was opened last month by Lord Chandos, chairman of Associated Electrical Industries.

THE new research and development centre of A.E.I.-Hotpoint at Peterborough was opened last month by Lord Chandos, chairman of Associated Electrical Industries.

Refrigerator manufacture at the main works is centred in their new production block completed last year. It occupies 112,000 sq. ft. of floor space with maximum use of an overhead conveyor system.

In the compressor assembly shop every precaution is taken to remove dust, dirt and damp. Operators use chamois leathers instead of wiping-rags; parts of the compressor, carefully graded, are carried in metal baskets through an ultrasonic washing machine in which perchlorethylene solution is vibrated at audio frequency to remove the least vestige of dirt and oil.

Here the mechanical part, the compressor, and the electrical part, the motor, are joined, the rotor being pressed on the compressor shaft in a six-ton press.

There are tests at every stage, until the final searching volumetric test against a "slave" unit of known accurate performance. Pressures up to 250 lb. per sq. inch have to be held. There are also instruments to detect the efficiency of valve sealing and electrical characteristics. End-caps are automatically welded on the shells and the assembly is black-dipped and allowed to dry in air before passing to the refrigerator assembly line.

Refrigerator units are assembled on temporary frames, which enable condensers, evaporators, suction and capillary tubes to be added. The compressors are charged with dry air, are leak-tested by immersing them in a water tank and looking for bubbles, and are dried out and evacuated in special ovens. The vacuum is checked and the system stands for eight hours before being charged with Freon refrigerant and oil.

Relays and wiring are fitted, every system is given a low ambient test, frost levels are checked and a thorough electrical check precedes its overhead journey into the main shop for assembly into the cabinet.

Manufacture of the evaporator takes place by the interesting process known as stitch welding. Two previously-stamped sheets of stainless steel are welded together to form a gas-tight continuous tube through the evaporator.

The sheets are passed between the edges of two copper discs which receive a surge of welding current

A view of the final assembly line in the new refrigerator factory at A.E.I. - Hotpoint, Peterborough.

every quarter of an inch. The edges of the evaporator are seam welded on another machine.

An electrostatic spraying plant is employed for finishing the cabinets. A conveyor carries the cabinet overhead, into the spraying booth. Here a swinging arm carries a fast-revolving disc to and fro, and the paint fed to the disc becomes a fine mist. The paint is charged with electricity and the cabinet, being earthed, receives an extremely even coating which is assisted by the good "tooth" given to the metal by pre-treatment. Drying is in infra-red ovens, after which the cabinets go to the assembly line. Here the glass-fibre insulation and the plastic liners, evaporator doors, shelves and other details are fitted, with stringent inspection and testing all the way. Ten per cent. of the production is actually tested under tropical conditions in a "hot room," where the controlled temperature is 100°F.

CHRYSLER'S IN IRELAND

Local Company Extends Activities

The former Government factory at Newtownabbey, Co. Antrim, N. Ireland, now the headquarters of the Everton Sheet Metal Works Ltd., which has assumed the distributorship for the whole of Ireland of Chrysler Airtemp, refrigeration, air-conditioning and heating equipment.

EVERTON Sheet Metal Works Ltd. of Newtownabbey, Co. Antrim, signed a marketing and distribution franchise last month with Chrysler Airtemp Ltd., and is now sole Irish distributor for this company's range of heating, air-conditioning and refrigeration equipment.

News of the agreement was released at a press conference at the Grand Central Hotel, Belfast. The announcement was made jointly by Mr. W. K. Bradley, director and general manager of Chrysler Airtemp Ltd., and by Mr. G. Leckie, general manager of Everton Sheet Metal Works Ltd.

Mr. Bradley said in Belfast: "Since we introduced this equipment in the United Kingdom we have made considerable progress in developing our marketing techniques and in pioneering new methods with new types of equipment. Today, when we introduce our products in Ireland we bring with us a more positive know-how in the application of our equipment to this country's particular requirements."

Mr. Leckie said: "Recently we have been building up our administrative and technical staff to enable us to widen our field of operation in specialist lines. Our past contacts in the air-conditioning fields have enabled us to acquire with confidence the Chrysler Airtemp distributorship in Ireland.

"We have grown in step with the general industrial expansion in this country and with the present rapid increase in business we look forward to further developments. We feel that our company is a fine example of private enterprise. We are very much a family concern and this enables us to attain a high standard of work at all levels."

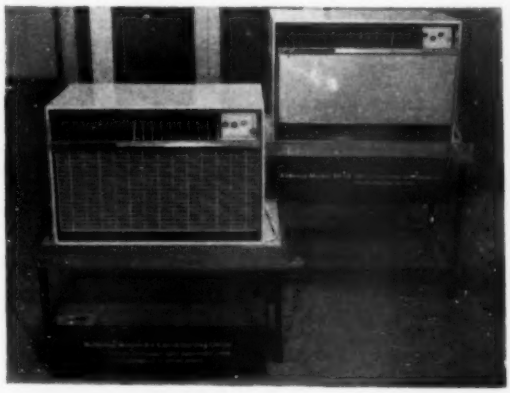
Everton Sheet Metal Works Ltd. has been established in Northern Ireland for more than 16 years. Its principal activity has been the manufacture of steel plate and sheet metal fabrications and contract work in general engineering, structural steelwork and in the installation of ventilation and dust extraction equipment.

Mr. J. Leckie, chairman and managing director, started the company in December, 1944, with a staff of three.

In 1947, and again in 1951, expansion of the company's activities necessitated moving to larger premises. In June 1959, the business became a limited company and moved to its present premises at Whitehouse, Newtownabbey, Co. Antrim. At the 30,000 sq. ft. ex-Government factory it now occupies, the company has a staff of almost 100 and is equipped with the most

TWO CHRYSLER AIRTEMPS

room air-conditioning units displayed recently in Belfast which are among the many items of refrigeration, air-conditioning and heating equipment now available in Ireland for the first time through Everton Sheet Metal Works Ltd., Irish distributors for all Chrysler Airtemp equipment.



up-to-date machinery including cranage facilities for handling loads weighing up to 10 tons.

Mr. Leckie also announced that Mr. S. R. Shaw has been appointed technical executive of the Airtemp division of Everton Sheet Metal

Mr. Shaw, aged 30, has served an industrial apprenticeship with a Northern Ireland firm of heating, ventilating and structural engineers. He has worked as a senior project engineer and technical representative in the heating and ventilating engineering field prior to taking up his present position. He is a member of the Institute of Heating & Ventilating Engineers.

Mr. Shaw has already established contact with commerce and industry throughout Ireland in order to make progress with his company's new distributorship.

A representative display of Chrysler Airtemp equipment was on show at the Grand Central Hotel, Belfast last month.

Many important guests attended a recent Chrysler Airtemp trade display at the Grand Central Hotel, Belfast. The display was staged jointly by Chrysler Airtemp Limited and its newly appointed distributor for the whole of Ireland, Everton Sheet Metal Works Ltd., of Belfast. A wide range of Airtemp refrigeration, air-conditioning and heating equipment was featured and more than 100 representatives of Irish industry and commerce as well as architects and heating and ventilating contractors visited the display. Photograph shows, left to right, Mr. George G. Leckie, director and general manager, Everton Sheet Metal Works Ltd., Mr. M. Dozier, head of U.K. desk, Department of State, Washington, Mr. S. S. Goodman, U.S. Consul in Belfast, Mr. James Leckie, managing director, Everton Sheet Metal Works Ltd., Mr. W. K. Bradley, director and general manager, Chrysler Airtemp Limited and Mr. F. Edwards, director Camco Ltd.

BRITISH FAIR IN MOSCOW (from page 697)

production shortly were, except for the paint finish, well up to the design standard of current models in the United Kingdom.

During the fair a number of large contracts were signed between Soviet trading organizations and British companies and negotiations are still taking place for further agreements. The joint communique issued by the president of the Board of Trade and the Soviet Minister for Foreign Trade towards the end of the fair was an encouraging indication to the hard-working exhibitors that the doors are opening for more and wider trade between Britain and the Soviet Union.

* * *

The Ross Group are planning extensive expansion of frozen food distribution in Scotland with Mr. W. N. Mackie, formerly with Birds Eye Foods, Ltd., as area manager for Scotland. Three new depots will distribute; Norie Ltd., meat producers, will handle the west of Scotland, Thomas Howden Ltd., of Edinburgh handling the east, and Messrs Mollison of Aberdeen, the north-east. Refrigerated transport vehicles will be introduced in each of these areas to help maintain continuity of delivery.

* * *

A Frozen Foods and Refrigeration Equipment Exhibition was staged by Birds Eye Foods Ltd. and Wm. Kemp & Co. (Refrigeration) Ltd. in the Ossington Hotel, Kilmarnock on May 30 to 31. The event was designed to present food retailers in this part of Ayrshire, the latest Prestcold units and the range of frozen foods available from Birds Eye to stock the Prestcold cabinets.

KIPPERS FOR MOSCOW

Mr. Peter Bell, assistant export manager of Mac Fisheries Limited, supervises the final stages of loading 2,000 pairs of kippers outside the company offices in Pudding Lane, London, in the Sterne semi-trailer illustrated in Red Square on page 694. The refrigerated trailer is 27 ft. long.

Alloy Tube with Internal Channels

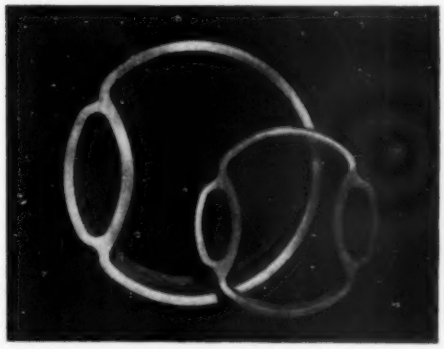
IMPERIAL Aluminium Company Limited are now marketing "Unitrace" tube in the U.K. "Unitrace," manufactured by Aluminium Company of America, is designed for use in the processing of chemical and food products, where liquids—for example, tar, oil, fat, chocolate—must be kept warm to prevent solidifying when being pumped from one location to another. It is equally effective where liquids have to be kept cool at a controlled temperature.

"Unitrace" is an extruded aluminium alloy tube combining two integral channels, the larger for the product line, the smaller for the tracer line carrying the heating or cooling medium.

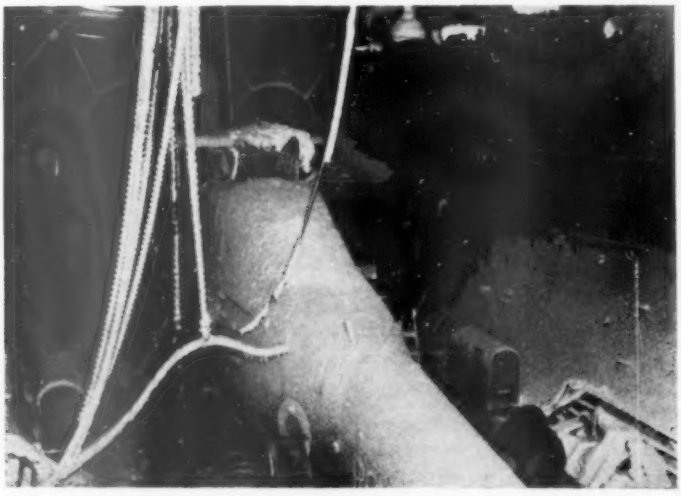
"Unitrace" is light and easily bent but has considerable strength and the integral construction provides excellent thermal characteristics. It is supplied in standard 30 ft. lengths and in seven standard sizes from 1 to 8 in. Outside diameter of the tube conforms to standard pipe sizes so that normal insulation can be fitted. Special flange fittings enable "Unitrace" lengths to be bolted together by standard flanges or to jacketed fittings by means of adaptor flanges.

Tracecaps enable welded joints to be made on straight runs, tees and cross-sections. Right-angle elbows having trace lines at the side, outside or inside, are available.

The range has now been increased by the addition of "Duotrace," with two tracer lines instead of one.



Section of Alcoa "Unitrace" and "Duotrace" tubes, marketed in the United Kingdom by Imperial Aluminium Co. Ltd.



HELICOPTER IN ARCTIC CHAMBER

During the 11 years it has been installed, the altitude and climatic chamber at Vickers-Armstrongs (Aircraft) Ltd., Weybridge, has been employed for a wide variety of tests.

Among the latest and most interesting of these is the series of sub-arctic trials carried out on a Westland Wessex Helicopter, shown in the accompanying photograph at a temperature of minus 35° C. (Tests at temperatures as low as minus 60° C. have been made.) During the test the machine was complete except for the rotor blades.

The chamber is enclosed in a "house" of insulation—floor, walls and roof being composed of six layers of 2 in. boards made of Onazote, manufactured and supplied by the Expanded Rubber Co. Ltd. Croydon, Surrey.

NEW MECHANICAL SEAL

Flexibox Limited have developed a new mechanical seal—the type DD for high speed shaft sealing applications where axial space is at a premium, which can cope with peripheral speeds up to 15,000 f.p.m., pressures up to 1,000 p.s.i.g. and temperatures up to 500° F.

The F. type DD is a face-type balanced mechanical seal of multi-spring design. It consists essentially of a housing which carries a resiliently mounted stationary rubbing face assembly consisting of a body insert and resilient packing. Face loading is provided by a number of small springs arranged around the flange of the stationary seal ring body. This ensures close control and uniform application of the face contact pressure. The rotary mating face should preferably be resiliently mounted.

Three variants of the basic design are available—O-ring fitted, chevron packed and "reverse balanced".

NEW URETHANE INSULATION

By A. HEGARTY

IT is claimed that better performance and more economy can be obtained in refrigerated equipment using a new type of foamed-in-place urethane insulation distributed by the Insulation Division of the Armstrong Cork Company, Pennsylvania.

The new material, " Armstrong Expandofoam," is a chemical product supplied as two liquid components which the equipment manufacturer can mix and expand into the equipment cavity to form a rigid, efficient urethane foam.

The high thermal efficiency of " Expandofoam " allows wall thicknesses to be cut almost in half, so 50 per cent. less insulation is required. The strength and toughness of " Expandofoam " allow cabinets to be redesigned, incorporating substantial economies by using lighter parts and eliminating framing members.

" Expandofoam's " high moisture and vapour resistance eliminates moisture infiltration problems and the expensive sealing methods often needed to combat them. By redesigning around " Expandofoam," interior dimensions can be enlarged without expanding exterior measurements, and extra durability and trouble-free service can be built into cabinets, it is claimed.

The new foamed urethane is composed of uniform, small, closed cells, and has unusual toughness and strength. Components are of low viscosity for easier handling and more thorough mixing, and can be mixed by hand or machine.

The liquid components are produced by the Chemical Division of General Tire and Rubber Company, Akron, Ohio, in co-operation with Armstrong Research. The formulation can be varied to provide different combinations of conductivities, densities, and degrees of strength and toughness to meet the insulation and design requirements of a wide variety of types of refrigerated equipment.

Armstrong also offers qualified engineering service to work with manufacturers in the design of refrigerated equipment, development of the most efficient " Expandofoam " system for each individual requirement, and technical evaluation of experimental or production models.

A TYPICAL FORMULATION

A typical " Expandofoam " formulation is the reaction product of a polyether based prepolymer combined with an activator and inflating agent to produce an insulation of minimum density with exceptionally good thermal efficiency. The components are mixed and poured into a cavity between skins of the compartment to be refrigerated. The liquids foam and solidify in place.

At normal room temperature, mould blown " Expandofoam " will expand to a density of 2 lb. per c.ft. The initial thermal conductivity of " Expandofoam " at 2lb. density averages 0.11 to 0.12. When foamed under normal conditions, " Expandofoam " will cure within 24 hours at room temperature into a stable foam.

" Expandofoam " will support any load normally encountered in conventional equipment without reinforcement by framing or load bearing members. Yield strength is 25 to 30 lb. per sq. in.

A 1 in. thickness of " Expandofoam " has a water vapour transmission rating of less than 1.0, and its closed cell structure eliminates " sponge " action, so the material remains dry on exposure to liquid water. It is odourless, resistant to fungus and bacteria, has good adhesion properties, has no corrosive or solvent effect on metal, is resistant to water, alcohol, petroleum base solvent and oils, and is easily handled in production.

THE SIMON MEMORIAL PRIZE

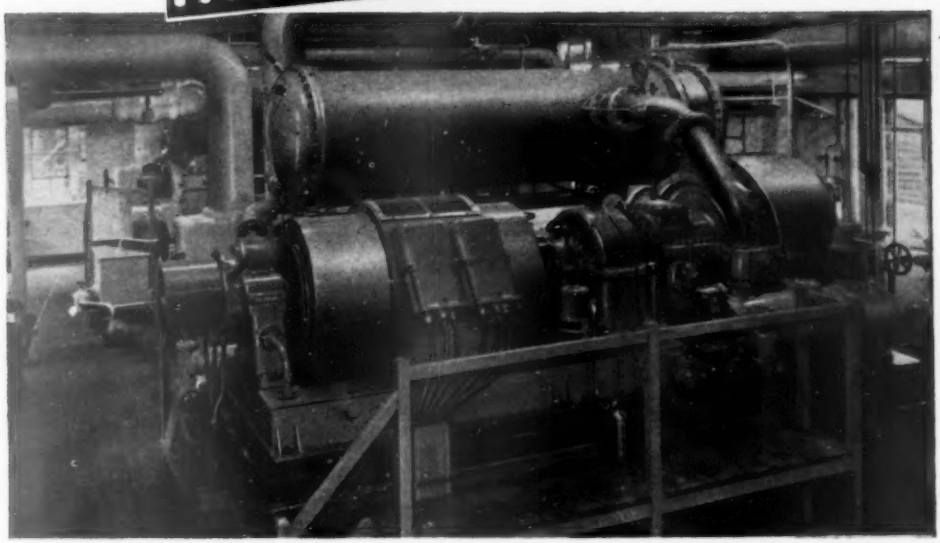
PROFESSOR Sir Francis Simon was an international figure in the field of low temperature physics. The low temperature school at the Clarendon Laboratory was largely his creation. Among his activities designed to bring scientists in universities and industry into closer contact, he was one of those instrumental in founding the Low Temperature Group of the Institute of Physics and Physical Society and was its first chairman. It was therefore natural that, after his death, the Low Temperature Group should have founded the Simon Memorial Prize which is financed from a fund to which many industrial organizations generously subscribed. The memorial prize is £250 which is awarded every two or three years to a scientist who has made major contributions in the field of low temperature physics.

The committee of the Low Temperature Group wish to announce that the Simon Memorial Prizeman for the year 1961 is Dr. I. M. Lifschitz of the Academy of Sciences of the Ukranian S.S.R., Kharkov*.

Dr. Lifschitz has made many penetrating contributions to the understanding of the structure of the fermi-surface in metals besides working on liquid helium. He has accepted this award and it is hoped that he will deliver the memorial lecture on September 19, at the Royal Institution.

*This announcement was made last month by the chairman of the Low Temperature Group of The Physical Society at a gathering of that section at The Clarendon Laboratory, Oxford.

1,800 TONS of REFRIGERATION for KODAK Ltd.



The illustration shows one of the four CENTRIFUGAL REFRIGERATING MACHINES supplied and installed by J. & E. Hall for the Harrow (Middlesex) Works of Kodak Ltd. They are used for controlling temperature and humidity during the processing of their products. With a total b.h.p. of 2875, the machines have an output of 21,600,000 B.t.u./h—equivalent to 1,800 tons of refrigeration!

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AP 378

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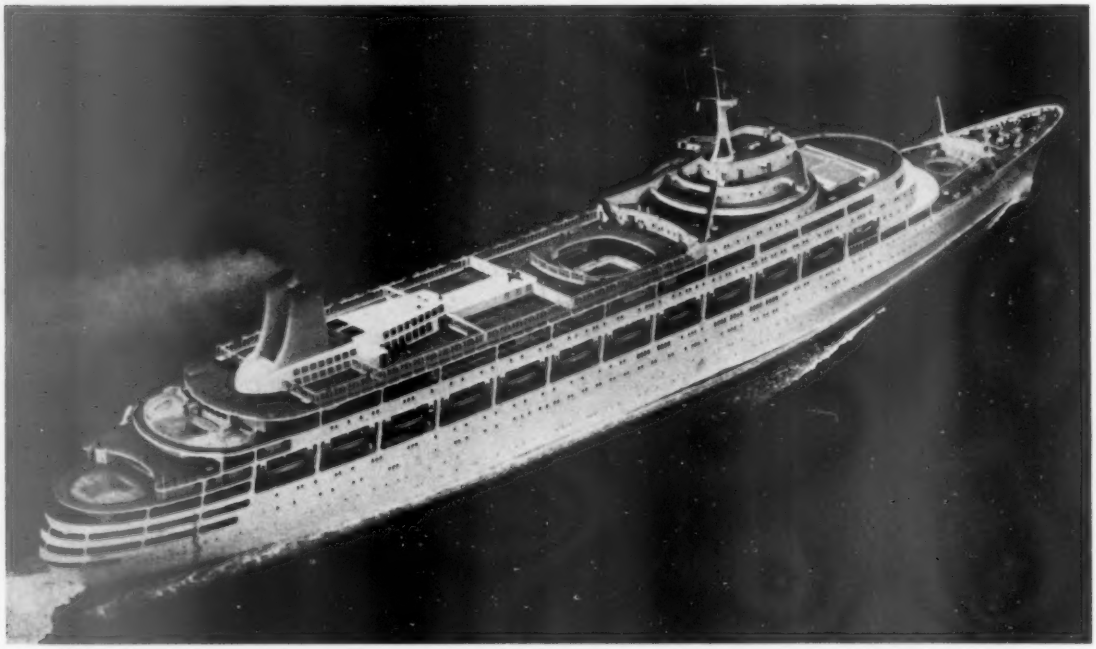

The creators of the CANBERRA have not duplicated earlier successes. They have anticipated trends and changes and a m to surpass what has gone before. Into the insulation of the provision chambers, cold stores and decks of this sh p that shapes the future was fitted ***over half a million bd. feet of*** . . .

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45,270 tons gross. 820 ft. long. Beam 102 ft. She carries 548 first class and 1690 tourist class passengers —more than any other passenger ship afloat.

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FREEZING PLANT EXPANSION IN MIDLANDS POULTRY GROUP

Oven-Ready Birds Output Rate—One per Second

FREEZING and cold storage plant extensions valued at over £100,000, which are to be installed during the next three months at the Craven Arms (Shropshire) headquarters of the J. P. Wood poultry group, will rocket its processed and packaged output of Chukie brand oven-ready birds to one every second.

A vital unit in this expansion programme is the provision of 100,000 c.ft. extra storage space for the pre-frozen birds. This new cold store will measure 80 ft. in length, 62 ft. (nearly the length of a cricket pitch) in width and 20 ft. in height.

The temperature maintained will be 0° to 5 ° F. produced by two 40 h.p. electric motors each driving J. and E. Hall Veebloc 6-cylinder compressors. The new storage unit will be separately housed in a structure of prefabricated heat-insulated panels. To yield maximum storage capacity, the coolers are ceiling-mounted and provided with two 24 in. aerofoil fans to disperse the air through openings in the ducts. De-frosting by a hot gycol circulation process is automatically set in motion twice daily by time switch.

The initial cost of this installation, later to be doubled in capacity, is estimated at £50,000.

In addition, a sum of £25,000 will be spent on a 1,200-bird-per-hour automatic blast freezing tunnel. Measuring 36 ft. 3 in. in length, with a width of 10ft. 3 in. and a height of 9 ft. 7 in., the tunnel will be maintained at a temperature between –20° and –40° F., by a 4-cylinder Hall compressor, driven by a 150 h.p. electric motor.

The processed birds, after bagging, enter the tunnel in wire basket. The cycling of the tunnel's intake is automatically arranged for six openings per hour for 200 birds ; the discharge of birds at the tunnel's other end is also automatic and in step with the intake rate. The complete passage for oven-ready Chukies through the automatic blast freezing tunnel takes 2½ hours.

To speed oven-ready turkey production of the Midwest enterprise, a £15,000 brine immersion plant is being installed.

The tank's dimensions will be 34 ft. 9 in., by 6 ft. 6 in., with a depth of 3 ft. The tank, which is insulated, will hold calcium chloride brine kept at a temperature of –10° F. by a Hall 6-cylinder Veebloc compressor belt-driven by an 85 h.p. electric motor. Its throughput will be 300 10-lb turkeys per hour, each bird being submitted to the brine treatment for one hour.

Finally, to provide flake ice for chilling and tenderising turkey carcases, a £6,000 ice-maker is to be installed with a potential of 8 tons of ice per day.

In itself, the provision of new plant to the extent of £100,000 within a few years only of the introduction to the market of oven-ready birds, is significant. More rare, however, is the ability of a private company to find such expansion finance within its own resources ; and with confidence in its customer potential to plan on such a scale.

It is of interest to recall that the J. P. Wood business is no newcomer to chicken and other table-bird production. The company stems from a family concern founded in 1834.

* * *

Associated Canners of Moorabbin, Victoria, have erected a prefabricated blast tunnel with two sliding doors, insulated with 6 in. thick Onazote faced with Zincanneal.

* * *

Following the announcement some few months ago that Eurovend Limited had formed an association with Schwelmer Eisenwerk Muller & Co. G.m.b.h., for the marketing of their milk vending equipment in the European theatre, it is now learned that tremendous interest was shown in their products at the recent Hanover Fair. Buyers from all over Europe and Scandinavia inspected the equipment on display and as a result Eurovend have on hand export orders to fulfil a requirement of over 1,000 machines.

Air-Conditioning in New BICC. McFadzean Laboratory

THE Satchwell electronic controls, used throughout for the heating and air-conditioning system in the new McFadzean Laboratory of British Insulated Calendar Cables Ltd. at Wood Lane which H.R.H. The Duke of Edinburgh opened last month, have been supplied by The Rheostatic Co. Ltd., a member of the Elliott-Automation Group.

For the purposes of heating, cooling and humidity control, the laboratory building is divided into two halves (east and west), each half being fed with air at the correct temperature and humidity to give comfortable conditions. A separate air-conditioning plant feeds each half, the air being distributed throughout the building through ducts. Satchwell " Duotronic " electronic controls regulate dampers so that the appropriate quantities of fresh air and re-circulated air are admitted to the plant which then mixes and filters the air before passing it on to heating and cooling batteries. Other " Duotronic " controls ensure that the appropriate amount of heating or cooling is supplied to these batteries so that the air is finally discharged into the rooms at the correct temperature to suit the prevailing conditions.

Another 10 sets of " Duotronic " equipment provide local zone control to look after local temperature variations which may occur in various parts of the building, particularly because of solar radiation.

The building embodies a considerable amount of glass in its construction and consequently in summer there is a tendency for overheating to occur on the south side. This is overcome by installing temperature detectors on the south side linked to the local controls which cause an increased supply of cooled air to be supplied to the warm area.

Humidity detectors are incorporated in the system and these feed appropriate signals to the air-conditioning plant so that the humidity is kept within the desirable limits to provide comfortable conditions.

CONTROLLED ENVIRONMENT RESEARCH

THE American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has announced that it has concluded an agreement with Kansas State University whereby the latter will continue the study of the controlled environment programme, carried on by the society during recent years. The terms of the agreement include the transfer of the society's environment facility to the Kansas State Environmental Research Centre, newly established by the Kansas State University of Agriculture and Applied Science at Manhattan, Kansas.

This is the society's first major decision regarding its research activities since it announced in December an expanded grants-in-aid programme to colleges and private laboratories and the closing of its laboratory in Cleveland, Ohio. The $150,000 controlled environment room, now housed in ASHRAE's laboratory, has been used for the past few years to investigate the reaction of healthy subjects to various thermal and radiant environments. The room will be disassembled by the university this summer and transported to Manhattan, Kansas. There it will be reassembled in a new building and operated under a co-operatively financed programme to augment the work now being completed in Cleveland.

Concurrently with this announcement, Robert H. Tull, president of ASHRAE, stated that the laboratory's solar calorimeter, which has been used for many years to study solar heat gained through glass and other structural components and the influence of shading devices on heat gain, will also be relocated. It is the society's intention to make this facility and its associated instrumentation available to a university laboratory or experiment station interested in research in this field.

In addition, Mr. Tull revealed that the laboratory's general-purpose instruments and equipment are up for sale.

At the prssent time, ASHRAE is reviewing its research programme and is seriously considering the reorganization of its many and varied research and technical committees. According to Mr. Tull, essentially all of the society's research and technical activities, exclusive of meeting programme and standards, will be handled by a single committee structure organized under the following group titles :

1. Fundamentals.
2. Heating and cooling loads.
3. Heating.
4. Ventilating and air-handling.
5. Refrigeration.
6. Air-conditioning.
7. Food science and refrigeration.
8. Domestic refrigerators and small refrigeration equipment.
9. Applied equipment.
10. Auxiliary equipment.

Without a laboratory, much more committee work will be required to generate and monitor the increased number of projects in co-operative institutions. The work will be in smaller " packages " and scattered geographically. The society anticipates that much of the future research will probably be of an applied rather than fundamental type and more closely aligned with industry problems.

The Kansas State University Environmental Research Centre has been established to (1) conduct research on human response to thermal environment as affecting health, comfort, learning and productivity, (2) conduct research on air pollution problems relating to health and comfort, (3) collect and disseminate information regarding man and his environment, and (4) provide an educational programme at the graduate level in environmental engineering.

For research programmes funded by ASHRAE, an advisory panel, consisting of members appointed by the society and by the university, will advise and assist the resident staff in carrying out the programme.

Kansas State University, through its mechanical engineering department, will assure the overhead and administration charges except on certain contracted projects and the mechanical engineering department will also provide one or two graduate research assistantships. Environmental research undertaken for ASHRAE will be on a co-operative basis, lasting two to five years per project.

If the presently conceived schedule can be met, environmental research will be resumed at Kansas State in the latter half of 1962.

GLASGOW SELF-SERVICE EXHIBITION

New ideas and equipment for the retail food trade were on show at a Self-Service Exhibition held at the Partick Burgh Hall, Glasgow, last month. The exhibition was the eighth to be organized jointly by four companies, Frigidaire Division of General Motors Ltd., Philips Electrical Ltd., National Cash Register Co., Ltd., and Frederick Sage & Co. Ltd.,

The exhibition took the form of a full-size, fully equipped self-service shop, and showed the latest equipment for the retailer, much of it being suitable for small business as well as large and also for non-self-service shops.

Refrigeration display equipment shown by Frigidaire included for the first time at these exhibitions examples from the " Talisman " range, including a new three-tier display case. Display of provisions, meat and frozen foods was represented and a series of Frigidaire-cooled automatic vending machines was also shown.

BENNETT APPOINTMENT

R. A. Bennett Ltd. Brownhills, Staffs, announce that Mr. Stan Wood, late of Zero Electric Ltd., has joined them in the capacity of commercial manager. Following on from the considerable interest shown on Bennett's stand at the Refrigeration Exhibition in the Robinair range of special servicing equipment for sealed systems the licensee's, Messrs. J. W. Pickavent & Co. Ltd., have already increased production quantities. The service trolley, the Dial-a-charge measuring glasses, crimping tools, process adapting tools and test cords are now on display in Bennett's self-service warehouse. Interested members of the trade are welcome to inspect same. To cover the need for high temperature silver soldering with component exchange in sealed system field service Bennett's are now handling the Sievert propane combined leak detector and brazing torch. This is also on show.

This is No. 5 in a series of advertisements by STAL Refrigeration AB—a company of the De Laval Ljungstrom Group.

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STAL produces a complete line of standardised components such as :

HD compressors (20—135 tons)
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STAL and its associates around the world, engineer these components into plants for a wide variety of applications.

Typical applications : Cold stores
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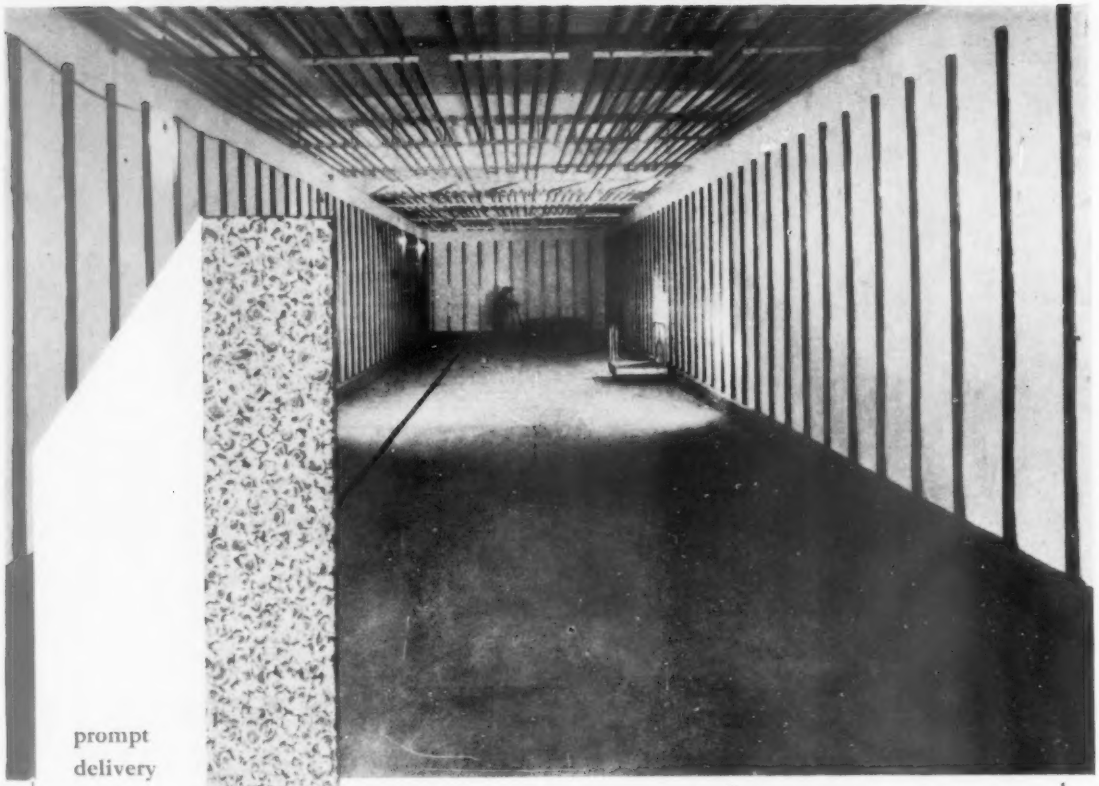

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NEW CELLAR COOLER

The accompanying illustration is of a new ½ h.p. air-conditioner-cellar cooling unit which Heat Pump and Refrigeration Limited have introduced on the market. The prototype of this unit was exhibited at Earls Court in April this year where it was met with a great deal of interest and admiration. This unit has been specifically designed for use in small cellars, store rooms etc., up to 2,000 c.ft. capacity and is extremely quiet when in operation.

The arrangements of the components no longer follow the conventional methods and this enabled Heat Pump & Refrigeration Ltd., to produce this efficient unit at a very low price of £115. Among the many features, the unit incorporates patented mesh fans which are of H.P.R. exclusive design. Both the evaporator and condenser are of all-copper construction. The unit is controlled from an adjustable thermostat and suitable for a range of temperatures from 50° to 60° F. Similar units incorporating a heat pump are also available at a price of £135.

The following is a brief specification :—

Cooling Capacity : 4,500 B.t.u. per hour at 60° FDB room remperature ; 80 per cent. RH ; 85 per cent. FDB outside temperature.

Mechanism. The refrigeration system is completely sealed and is powered by a ½ h.p. Sterne Tecumseh sealed motor compressor which is resiliently mounted to ensure quiet operation. Maximum efficiency, compactness and quiet running are obtained by incorporating exclusive H.P.R. designed coils, fans and combined muffler heat exchanger. The muffler prevents liquid "slugging" into the compressor. A special drip tray is incorporated to remove all condensate from the evaporator coil.

Fans.—The H.P.R. patented mesh fans are incorporated to ensure quiet air circulation. Indoor fan moves 220 c.ft. per minute.

Controls. The unit is controlled by an adjustable thermostat for temperatures between 50° to 60° F.

Wiring Requirements : 15 Amps. 210 to 250 v. a.c. only. The unit is supplied with 6 ft. 3-core flex.

Power Consumption : 0·45 to 0·70 kW per hour.

Insulation. The unit is thermally and acoustically insulated with vermin-proof material.

Dimensions. Height 15 in., width 27½ in., depth 22 in., weight 155 lb.

Heavy Duty Packaged Air-Conditioning Plant

CARLYLE Air Conditioning & Refrigeration Ltd., London, are now marketing a series of self-contained air-conditioning units—the 41E and 41EE series—which have capacities of from 20 to 50 tons of refrigeration, and are suitable for larger commercial and industrial applications in factories, offices and stores. The units provide all the air-conditioning functions—cooling, heating, dehumidifying, filtering and circulation in one compact package, suitable for installing either singly or in multiples as part of an air-conditioning system which may involve some hundreds of tons in total capacity. The principal advantages in this method of air-conditioning are the reductions in first and installed cost, operation charges, and the utilization of only the minimum amount of plant space.

The 41E and 41EE series are available with water-cooled condensers, but can also be arranged for use with Carlyle air-cooled or evaporative condensers. Each unit can be located either in an internal plant room, or if desired, externally in which case a weather-proofing kit is available.

Basic construction of the model 41E consists of a welded angle iron frame enclosed by overlapping steel panels. The base section includes either two or three Carlyle six-cylinder hermetic compressors, two water-cooled condensers, a four-row cooling coil, high velocity permanent cleanable filters and compressor and fan starters.

Standing 8 ft. in height, the 20 to 30 ton 41E units measure 7 ft. 9 in. long and 2 ft. 11 in. deep, whilst the 40 to 50 tons models (series 41EE) are 10 ft. 7 in. long by 3 ft. 10 in. deep and are 8 ft. 10 in. high when the fan section is arranged vertically.

The **Clayton Dewandre Co. Ltd.,** have issued new information on their "Clayton-Still" wire-wound heat transfer tubes. They are used for heat transfer between oil and air, water and gases, water and oil, and for refrigeration. This tube is a heat-exchanger, the extended surface of which consists of wire wound into elongated loops which are bonded to the basic tube in a helical formation. The rate of heat transfer to or from a small-diameter wire is extremely high, and this, combined with the high surface ratio, and aided by the turbulence induced by the formation of the wire, gives excellent coefficients of heat transfer per foot run.

PRESTCOLD INTRODUCES "NUVISION" DISPLAY COUNTER

A new refrigerated display/storage counter known as the "Nuvision" has been introduced by **Prestcold.** The cabinet offers refrigerated display, easily accessible for pleasant convenient non-time-wasting service, true refrigerated storage—no loss of counter space—display at the correct level and completely self-contained design for easy installation.

The display area is enclosed on the front, ends, and top but is completely open at the rear, has a refrigerated deck size of 60½ in. by 22 in.—nearly 10 sq. ft. of refrigerated display deck, easily and conveniently visible through an inclined glazed front wondow.

DO NOT TELL SECRETS!

By LORD MESTON

A MAN may learn certain secrets in the course of his employment. When he leaves that employment, is he entitled to divulge those secrets to other persons, who may incidentally be rivals to his former employers ?

The rule is that an employee is under an implied obligation not to disclose or make public professional or trade secrets or confidential information which he learns by reason of his employment ; and he will be restrained by injunction from publishing such secret information.

A few cases on this rule may be generally interesting. In *Merryweather -v- Moore*, the plaintiffs were a firm of engine-makers. The defendant, upon completing a term of apprenticeship with the plaintiffs, was retained in their employment as a paid clerk. Later the defendant left the plaintiffs' service for that of another firm of engine-makers. Two days before leaving the plaintiff's service he compiled for his own purposes, and without their knowledge and consent, a table of dimensions of various types of engines made by them ; and this table he had in his possession when he entered the service of his new employers, who subsequently exposed for sale an engine of dimensions corresponding to dimensions given in the table. It was held that, in compiling and retaining the table for his own purposes, the defendant committed an abuse of the confidence ordinarily existing between a clerk and his employer. Such confidence implies that a servant shall not use, except for the purposes of service, the opportunities which that service gives him of gaining information. Accordingly, the plaintiffs were entitled to an injunction restraining the defendant from publishing or communicating the table or its contents to anyone.

Passing from engine-makers to people who deal in live game, we may refer to the case of *Robb -v- Green*. The plaintiff was a dealer in live game and eggs. The chief part of his business consisted in procuring the eggs, and in the hatching, rearing and sale of game birds. He occupied two " game farms " in the country where he kept a large stock of upwards of 5,000 laying pheasants and where he sold about 150,000 pheasants' eggs in a year. He also supplied live pheasants, for shooting as well as for stock purposes. His customers were numerous, and for the most part were country gentlemen and their keepers ; and their names and addresses were collected together in his order-book. The plaintiff was desirous of engaging a manager, and he had an interview with the defendant, when he explained the nature of the business of a game farm ; and the plaintiff stated that of course he relied on the defendant not to impart any information about the business done by the farm, and to treat everything in connexion with the farm in strict confidence. Terms of remuneration having been agreed, the defendant was duly engaged as manager. About four years later it came to the knowledge of the plaintiff that the defendant was carrying on a similar business on his own at premises described as " The Game Farm, Henley." The defendant sent two circulars addressed, respectively, one to a great number of the plaintiff's customers whose names and addresses were contained in the order-book, and the other to game-keepers whose names and addresses were also in the order-book. These names and addresses in the order-book had been copied from that book into a list by the defendant whilst in the service of the plaintiff, clandestinely, and without his master's knowledge or authority, and for the purpose of using it to solicit his master's customers to give their custom to him. It was held that it was an implied term of the contract of service that the defendant would observe good faith towards his master during the existence of the confidential relation between them, and that the defendant's conduct was a breach of that contract in respect of which the plaintiff was entitled to damages and an injunction.

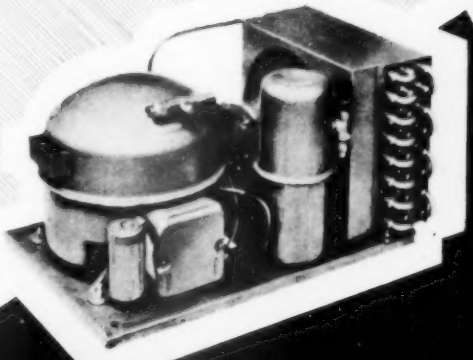
It is in connexion with secret processes that a very strict attitude is adopted. On the same principle as above stated, an ex-servant who has been confidentially employed in the manufacture of an article under a secret process is under an implied obligation to his late master not to use or disclose any knowledge or information as to that secret process acquired by him during his employment. This principle applies to information acquired and retained in the servant's memory as well as to information committed in writing and existing in a tangible form.

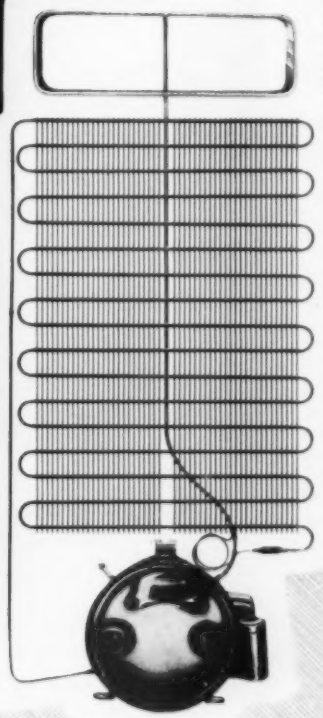
In *Amber Size and Chemical Company Limited -v- Menzel*, the plaintiffs manufactured size, called amber size, by a secret process comprising a secret mixture which was added to rosin size at the proper critical moment. The materials, proportions, and density of the mixture and the critical moment for adding it to the rosin were all-important parts of the secret process. The defendant entered the plaintiffs employ and was at once told that the process was secret. He was subsequently instructed how and when to add the secret mixture to the rosin size, but he was not told the details of the mixture, which was prepared by an employee in another room. During the course of his employment the defendant found out the materials of the mixture which he had to fetch from the mixing room, but he did not find out the proportions or density. He ascertained that the plaintiffs used a very special form of hydrometer. After six years the defendant left the plaintiff's employment and entered the employ of a rival firm as size-maker with the view of making size of the same quality as amber size. He obtained a hydrometer exactly similar to that of the plaintiffs, but found the results unsatisfactory, the fact being that the graduations of the plaintiffs' hydrometer were wrongly numbered in order to keep the real density secret. The defendant therefore did not know the exact density of the plaintiffs' mixture, but he knew the materials and that it was a strong solution. The defendant represented to his new employers and others that he could make the plaintiffs' size, and on these representations the new employers for the first time embarked on the business of size making. A sample of the defendant's size, and a sample purchased from a customer of the plaintiffs were analysed and found to contain the same ingredients, namely, water, free rosin, combined rosin, soda, etc., though in slightly different proportions. The Court granted the plaintiffs an injunction to restrain the defendant from using the whole or any part of the plaintiffs' secret method or process of manufacture of size, the knowledge of which was acquired by him during his employment by the plaintiffs, and from disclosing to any other person, company or firm any information with respect thereto.

A servant is, however, entitled after the termination of the service to make use of the knowledge honestly acquired by him in the course of his service, so long as it was not acquired surreptitiously, or entrusted to him expressly or impliedly in confidence.

An employee is not violating any contract or obligation

L'UNITE HERMETIQUE S.A.





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One phase - three phase

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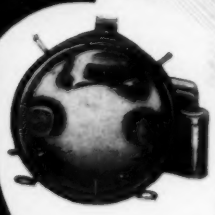
From 1/14 to 1/6 HP. 1500 RPM and 3000 RPM



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by using his knowledge of the system, organisation, and general methods of business of his former employers. This is something quite different from divulging secrets or confidential information which a man has learnt by reason of his employment.

One really has to look at all the circumstances to see whether an employee has been guilty of any breach of confidence. In the following case the fact that the defendants were directors of a company, and not in a subordinate position, makes no difference to the principle involved. Thus, in *Worsley & Co. Ltd., -v- Cooper*, the defendants were in the employment of the plaintiff company, who were paper merchants, and later the defendants became directors of that company. One of the defendants for several years travelled for the company and prepared a sample book and price list of the papers which the company sold. In it the various types of papers bore names—in some cases those in general use in the trade, and in others names of a fancy description—the names of the mills from which the papers came being, as far as possible, kept secret. Later, the defendants were bought out of the plaintiff company and resigned their directorships. They thereupon set up in business on their own account as paper merchants, and they issued a price list of precisely the same arrangement as that of the plaintiff company, save that in many cases the papers were given new fancy names. It was held that the confidential information which the defendants had acquired while in the employment of the plaintiff company, and the use they had made of it subsequently, were not a breach of any express contract. The information had been obtained openly and honestly, and was of such a nature that the defendants were bound to acquire it and they were largely responsible for it. The information was not in the nature of a trade secret, and the conduct of the defendants in the use they made of it was not an actionable wrong.

In the above case it was also held that where, for their own purposes, distributors of goods do not willingly disclose the names of the manufacturers of those goods, the fact that such names are kept secret does not make the knowledge of them a " trade secret " in the sense in which that term is used in cases dealing with the disclosure of trade secrets.

In conclusion, let it be remembered that a discovery made by a servant in the course of his employment and in his employers time is the property of the employer and not of the servant.

Novel Type Biological Freezer

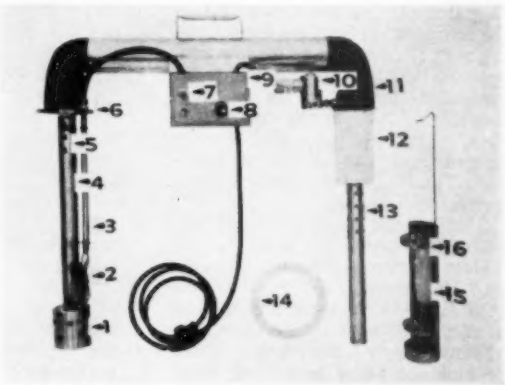
UNION Carbide Corporation in the United States has recently developed an entirely new kind biological freezer, designated " BF-1," for the accurate and automatic control in freezing bull semen and other biological materials with liquid nitrogen.

The new freezer was specifically engineered to meet the artificial breeding industry's need for a reliable, low-cost, liquid nitrogen freezer. It is compact, portable, and entirely automatic. Designed to operate with standard liquid nitrogen equipment, the device provides a highly efficient system for freezing 504 ampules of bull semen in about 40 minutes.

A proper controlled cooling rate is an essential prerequisite for the successful low-temperature preservation of bull semen and other biological materials. The new freezer functions by vaporizing the liquid nitrogen in an LNR-25-B liquid nitrogen refrigerator at a predetermined rate. This cold vapour then moves through the transfer tube of the freezer into a second LNR-25-B liquid nitrogen refrigerator in which 504 1-cc ampules have been placed. Through this controlled movement of cold nitrogen vapour into the ampule-laden liquid nitrogen refrigerator, the desired cooling rate is obtained. The BF-1 programmed at the factory to cool the semen at a rate of 1° to 2° C. per minute between -5° C. and -15° C.;

The "BF-1" connected to two LNR-25-B liquid nitrogen refrigerators.

and then at 3° to 5° C. per minute to a maximum terminal temperature of -79° C. These cooling rates have been found to give optimal results for freezing bull semen. Cooling rates and terminal temperatures can be altered to meet the requirements for successful freeze preservation of other biological materials.



The BK-1 freezer:—

1. Heater
2. Terminal block
3. Heater cable conduit
4. Vapour transfer tube
5. Vapour inlets
6. Flange
7. Control light
8. Index knob
9. Control box
10. Solenoid valve
11. Insulation
12. Neck tube plug with grooves
13. Vapour outlets
14. Aligning collar
15. Canister
16. Semen rack spacer

After the freezing cycle is completed, the refrigerator is filled with liquid nitrogen from an LS-110 container connected to it—placing the frozen semen in storage until needed. A buzzer then sounds indicating completion of the entire operation, and the freezer is automatically turned of.

BULLETIN OF THE INTERNATIONAL INSTITUTE OF REFRIGERATION No. 2, 1961.

Reviewed by

Dr. EZER GRIFFITHS
O.B.E., F.R.S.
Hon. Pres. of the I.I.R.

IN the autumn of 1961 the I.I.R. will hold many meetings under its auspices in this country : the Technical Board, Commissions 2, 3 and 8 in Cambridge, and Commissions 1 and 9 in London.

The two main topics to be dealt with by Commission 1 are methods for the large scale production of liquefied gas and temperature measurements below 1° K.

As regards the activities of national associations we note that the Refrigeration Research Foundation, U.S.A., had a seminar in February of this year where the main topics were packaging and warehousing.

This bulletin supplies information concerning research work in the National Bureau of Standards U.S.A. Of particular interest to workers in the refrigeration field are the following :—" Thermocouples for low temperature use," " Improvements of evacuated laminates for thermal insulation," " Cryogenic engineering data," " Physical properties of some reactor materials at low temperatures " and " Low temperature transformations in steels."

The bulletin contains about 200 abstracts. Among those under " Heat Transmission " we note one on " Heat transfer at the surface of a cold liquid"; the topic is of interest in connexion with the condensation of atmospheric water at the surface of a chilled water tank used in ice factories.

Another abstract deals with local and average heat transfer and pressure drop for refrigerants evaporating in horizontal tubes.

The heading " Production and distribution of cold " covers a number of abstracts including " A cascade refrigeration system for −85° C. process cooling," " Refrigeration process with refrigerant mixture and its possible practical application," " The use of ' Freon 143 ' in single stage low temperature machines " and two abstracts dealing with deaeration of refrigerating plants.

Under " Mechanical compression" there is an account of automation of compressor of Moscow cold store, No. 12, which is the largest cold store in that country. Another abstract deals with drawing Watt's diagram for small hermetically sealed compressors.

One abstract deals with the characteristics of single stage centrifugal compressors.

Two other abstracts in the same group might be noted : " Testing cooling tower performance " and " A simplified method for the calculation of evaporative condensers."

Thermoelectric refrigerators are the subject matter of four abstracts. A cubic foot capacity cold box has been produced, suitable for carrying in the boot of a car, taking a current from a car battery. It has a block of 182 thermocouples and will reduce the air temperature by 20° to 30° C.

Under the heading of " Distribution of cold " there are many abstracts of interest : " Economic heat exchanger design " " The performance of extended surface air-conditioning coils," " Electrically defrosted cooling coils " and " Hot gas defrosting."

Mention might be made of two of the abstracts under the heading " Insulation " ; " Use of cellular synthetic insulating materials for construction " and " The use of cellular foams in industry and transport." Both contain information as to the methods of application. " Cause of frost heave " is the subject matter of an abstract entitled " The warming of the floor under low temperature refrigerated rooms."

" A unique solution for the storage of fruit " describes the equipment in the quarries at Issy-les-Moulineaux, near Paris.

Under the heading " Air-conditioning installations " we note abstracts entitled " Comparison of the comfort indices " and " Some particular diagrams for double duct air-conditioning plants," " Gas and vapour extraction by means of activated carbon."

Ice adhesion studies are in hand at the New York Naval Shipyard to produce a permanent or semi-permanent surface coating that will be icephobic.

A lengthy abstract describes the station at Antony, France, for testing transport vehicles under controlled temperatures.

Dealing with the insulation of refrigerated ships, the author stresses that the design of the hull should take into consideration the insulation as regards ribs, wall strainers and girders. In an example quoted, a gain of 1 per cent. in the useful volume of the hold would result in the receipts being increased by N.F.798,600 for a banana ship. An abstract entitled " Chemicals and Refrigeration " states that the " big five " in the fluorocarbon group occupy places in 90 per cent. of the new commercial and industrial equipment and virtually 100 per cent. in air-conditioning.

A number of abstracts relate to the properties of materials at low temperatures.

Two abstracts deal with protection against rust in skating rinks.

Under the heading " Refrigeration as regards plants and food products from plants " we note an abstract entitled: " Developments in new food preservation techniques in the U.S.A." and another on " Accelerated freeze-drying."

A lengthy abstract deals with the gas storage of apples, effect on colour and keeping quality. Another refers to the keeping quality of apples and pears as affected by delay in cooling after harvest.

Storage diseases such as " bitter-pit," " Jonathan breakdown, " " spot " and " scald," receive consideration.

There is an abstract summarising the data known at present on the cold storage of vegetables.

In the section relating to meat there are two abstracts : one, on " Discoloration of chilled meat by nitrite of microbial origin " and another on " Improvement of freezer efficiency." A lengthy abstract is headed " The effect on flavour of holding frozen chicken for selected periods." It records the preferences of buyers of whole and of chicken parts. Another abstract is entitled " Moisture levels in frozen poultry as related to thawing losses, cooking losses and palatability."

One abstract under the heading " Fish " gives information on the use of resistance thermometers for measuring the temperature of frozen fish.

A long abstract is devoted to the equipment of a freezing trawler.

Five abstracts relate to wine cooling.

There is a full abstract of a paper which appeared in J. Amer. Dietetic Assn. on prepared frozen foods.

Under " Regulations and Standards " we note reference to Swedish regulations concerning pressure vessels and pipe lines.

New publications received at the Institute's library include several books published in the U.S.S.R. the

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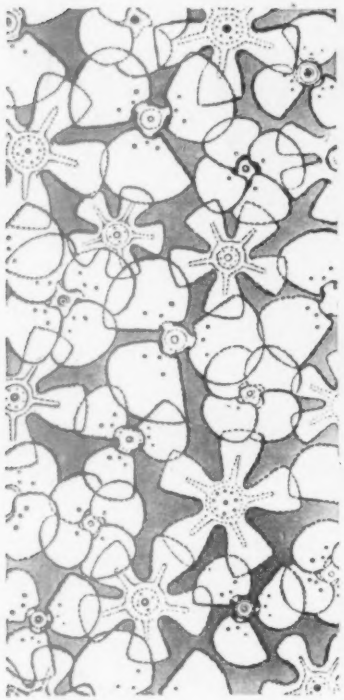

AIROTORS?
YES, SIR
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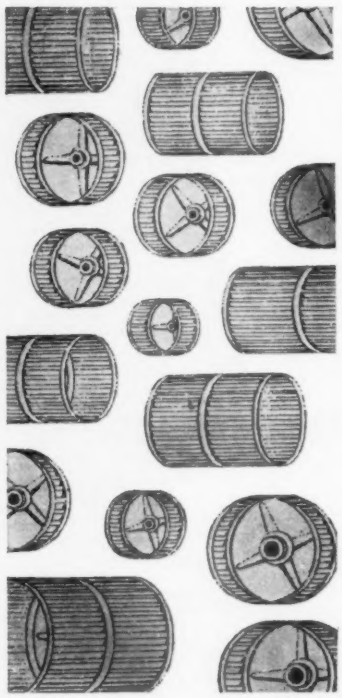
IN THE COUNTRY



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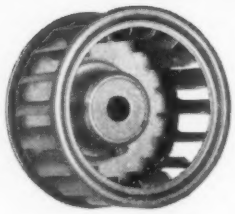

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titles, translated, being :—" Microbiology of the cold storage of foodstuffs," " Manufacture and applications of dry ice," " Construction of buildings for refrigerating plants," " Regulations about safety technique in ammonia refrigerating plants," and rules for " Freon 12."

The proceedings of the meeting of fish processing technologists held in Rotterdam in 1956 has been published in English by the Ministry of Agriculture, Fisheries and Food, The Hague. It contains 260 pages.

The first volume of a three-volume handbook entitled " Technique of artificial refrigeration " has been published in Leningrad.

Other U.S.S.R. publications are " Repair of refrigerating machines and plants," and for technological schools " Principles of refrigerating technique," and " Refrigerating machines and plants."

Finally, the bulletin gives a list of enthalpy diagrams (Mollier), their size and price obtainable from the Institute.

ERA APPOINTMENTS

At the last meeting of the council of the **Electrical Research Association,** it was agreed that the vice-chairman, Mr. L. Rotherham, should be invited to take the chair for the year 1961–2 and he was duly elected to take office immediately following the annual general meeting on May 3, 1961.At the same meeting Mr. S. E. Goodall was elected vice-chairman of the council.

Mr. Rotherham is the member for research, Central Electricity Generating Board. He received his early education at Strutt School, Belper, after which he proceeded to University College, London. From 1935–46 he was a physicist at the Brown-Firth Research Laboratories, from 1946–50 head of metallurgy department, Royal Aircraft Establishment, Farnborough, and from 1950–8 director of research and development, United Kingdom Atomic Energy Authority, Industrial Group, Risley. Mr. Rotherham is a Fellow of University College and is the author of various scientific and technical papers.

Mr. Goodall, who is director of engineering of Associated Electrical Industries (Woolwich) Ltd. and a director of Telephone Cables Ltd., was educated at Queen Mary College, London University. He was chairman of the Institution of Electrical Engineers Supply Section in 1950–1 and president of the Institution of Electrical Engineers in 1958–9. He is at present vice-chairman of the Institution of Electrical Engineers Wiring Regulations Committee and chairman of the National Inspection Council for Electrical Installation Contracting. Before entering the cable industry in 1944, Mr. Goodall spent 15 years in the research laboratories of Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester. Prior to that he was a telephone engineer with Siemens Bros.

PRESTCOLD REDUCTIONS

One of the first significant results following Prestcold's recent move to the giant new factory at Swansea, South Wales, is a price reduction of one of their most popular commercial refrigerators.

First Model From Swansea

The CC132—a frozen food conservator of 13 c.ft. capacity and often termed as Prestcold's five million pound 'fridge due to it being the first model to come from the production lines at the new factory—has been reduced in price to £129 10s. including delivery and installation. This represents a saving of almost £10

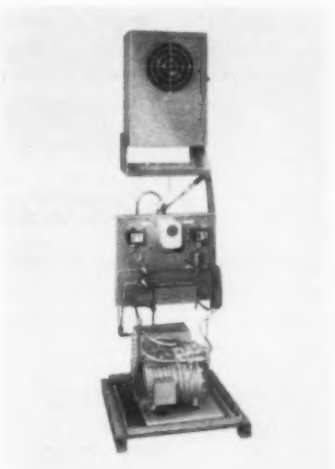
Since its introduction last year, the CC132 has been hailed by the trade press and retail food industry as "one of the most outstanding refrigerators of its type in the country." It is because of this enormous popularity—particularly among grocers and other retail food outlets where floor space is limited—that Prestcold have been able to make this present price reduction. The model is being produced in substantial quantities and, in line with a policy of volume production, this has led to a high standard of factory efficiency which, in turn, has brought down manufacturing costs.

FOOD PRODUCTION IN SCOTLAND

Quick frozen food production at Smedley's Blairgowrie factory last year was 80 per cent up on the previous record year, Mr. F. J. Beeton told those attending a Smedley's staff gathering. There would be a major overhaul of plant at the factory before June 1st, in preparation for new production and expansion. Mr. G. P. Smedley said that they were introducing a new line at Blairgowrie which would not only help the factory but help local growers. This new line would be tried out at the plant and if it proved as successful as they expected, it would be extended to the Dundee factory. He anticipated year-round working at Blairgowrie and a busier time than ever before. Coincidental with this factory expansion the firm was launching a sales drive to increase home and exports markets. He would visit North and South America to meet the ffirms selling Smedley products in these areas. Export trade had been climbing steadily over the past six years and he looked forward to the time when they would be selling as much abroad as in Britain.

Lochinver Fish Selling Co. Ltd., is planning the development of an ice-making factory at Lochinver, in Sutherlandshire, to provide ice for the local fishing fleet which meantime relies for its supplies on Wick and Aberdeen involving considerable transport to the North West Highland area.

NEW MARCO PRODUCTS



Marco Refrigerators Ltd. this month showed some of their new products to the Press at the Grosvenor Hotel, London. Included were the recently-introduced cabinets, for the frozen food range, i.e., "Florida," "Californian" display cases, and the "New Yorker" dual temperature display case. Both the "Florida" and "Californian" were introduced during the latter part of 1960, and have established themselves successfully. The "New Yorker" is a new model introduced as from July 1. Illustrated is the Marco "Thermobank," an auto-defrost system; this auto-defrost cycle is completely natural and entirely dependent on vitalising heat already generated by the refrigeration plant—resulting in large savings in running costs.

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for use on land and at sea.
7 to 20 stations to suit Purchasers
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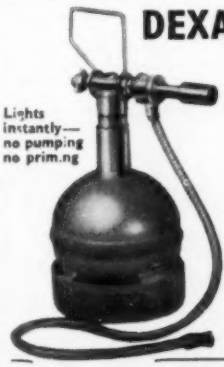
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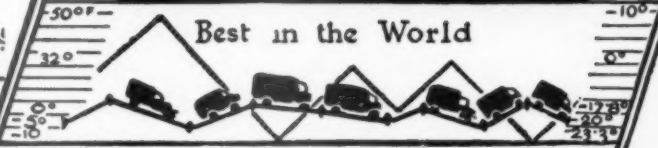

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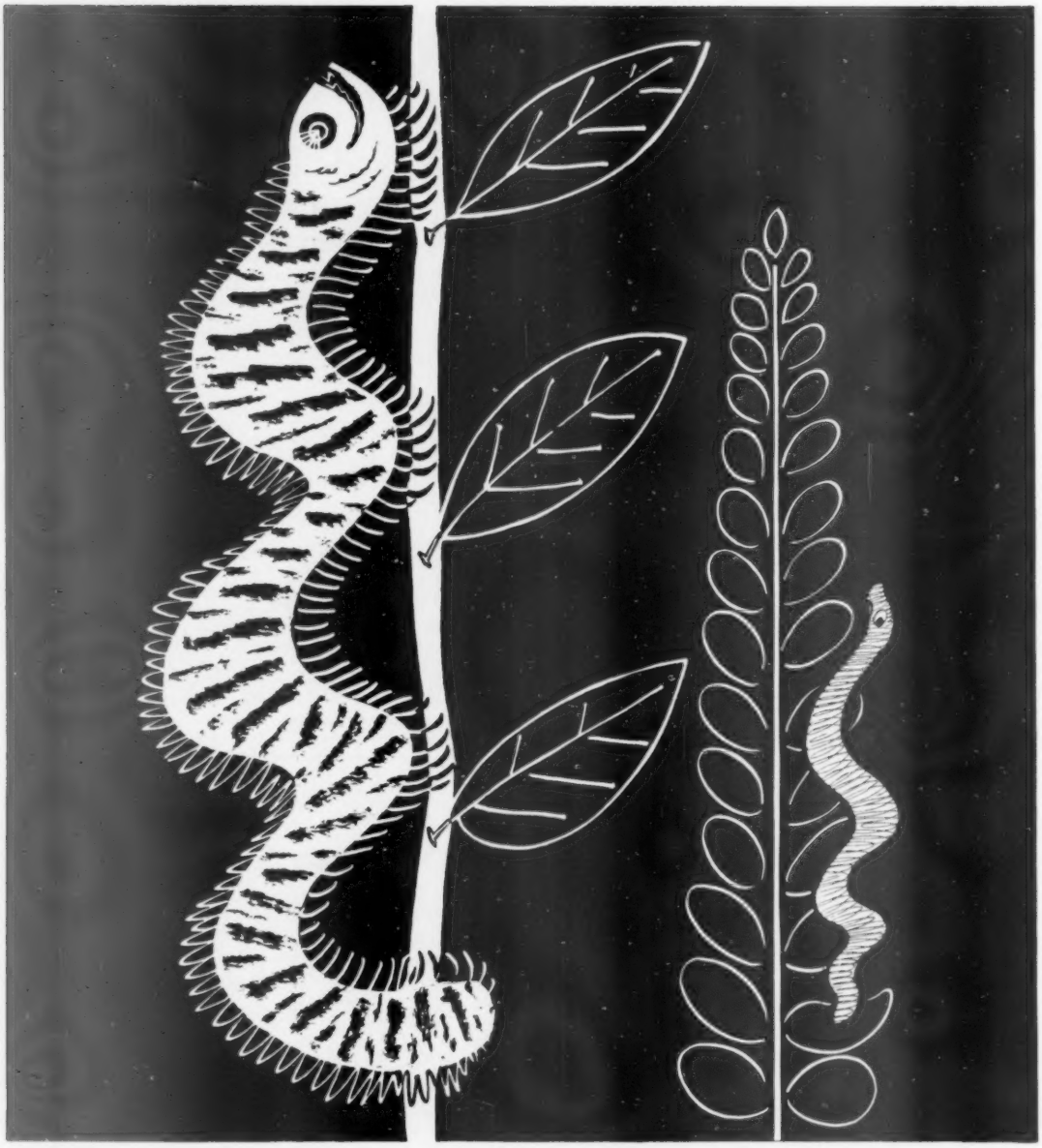

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Rigid Polyurethane Foams

– NEW SYSTEMS OF INSULATION FOR REFRIGERATION AND COLD STORE APPLICATIONS*

by

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POLYURETHANE foams have established themselves over the past few years as new materials of novel properties capable of being used in a variety of industries. The chemical background to their production can be defined very simply as the simultaneous formation of a gas and a polyurethane polymer from a hydroxyl-containing resin and a polyisocyanate under such conditions that the polymer is expanded by the gas. By correct choice of the resin and isocyanate the final foam may be flexible or rigid in character. The expansion of the gas may be achieved by reaction of the isocyanate with water with the formation of carbon dioxide or by incorporating a low-boiling liquid in the mix. In the latter case the exothermic nature of the polyurethane reactions is utilized to create the necessary expansion(1).

The first industrial development of rigid foam was in the aircraft industry ; the foam was applied by *in situ* techniques and was generally used for its high strength characteristics. For these specialized uses a batch process with mixing times of 15 to 30 minutes was acceptable and the industry was prepared to take precautions to overcome the toxic hazard from the low molecular weight isocyanates.

Even in these early days the insulation industry was interested in these new plastic foams, but it was quickly apparent that a non-toxic system with more simple process instruction would be essential if the polyurethane foams were to be developed in this field. With the introduction of isocyantes of the diisocyanatodiphenylmethane type the toxic hazards from the vapour were overcome and the manufacturing process greatly simplified.

Although new materials of improved properties have been introduced into the insulation industry during recent years they were applied by the traditional methods. Their effectiveness as insulants was therefore reduced by the same factors associated with the difficulties of erection as were applicable to the older traditional insulating materials.

The development of the polyurethane rigid foam system produced a cellular material with good insulation properties, but the idea of preparing the insulant on the site from its basic components offered an entirely new approach to the problems associated with the erection and application of insulation.

The idea of metering, mixing and pouring a liquid into a cavity and allowing it to react and form a cellular material in the space to be insulated was basically simple, but, not unnaturally, many difficulties unknown at that time had still to be overcome. Machines had to be designed which would handle and meter the very reactive chemicals, portable mixers built for delivering the liquid foam and application techniques developed for applying the foam into the many different shapes and form to be filled. Another problem to be overcome was the training of personnel unused to chemical operations to carry out the manufacture of the foam. In practice, therefore, the formulations devised had to be robust and consistent in behaviour so that the combination could be relied on to make the same quality of foam in cavities of widely different and irregular cross section. This was a formidable problem even for the chemist accustomed to chemical reactions since his manufacturing vessel was now variable in size and shape.

Nevertheless, the equipment and chemicals were developed to the stage that polyurethane foam was used to insulate holds and provision rooms on ships and in cold land stores. It was found, however, that with these early machines and chemicals that although the finished result was technically satisfactory and the advantages of *in situ* techniques demonstrated(2), the rigid foam was economically attractive only where the superior technical properties commanded a premium. Further improvements in chemicals and equipment were necessary.

During the past 12 months big advances have been made in both chemicals and equipment which have overcome many of these difficulties. The technical properties of the foam have been improved, the applications techniques simplified, and the overall costs reduced.

Chemicals

In the early systems the blowing agent was carbon dioxide, produced by the reaction of the isocyanate

* Presented at the recent Refrigeration and Air-Conditioning Convention at Earls Court.

with water. It was thought that the introduction of a volatile liquid which could be volatilized by the heat of the chemical reactions would assist in reducing the overall density of the foam. This concept has been proved successful in practice. Fluorochlorohydrocarbons such as fluorotrichloromethane ($CC1_3F$) have been found most satisfactory. The fluorochlorohydrocarbons have the advantage over other solvents possessing similar volatility in that they are non-toxic, non-inflammable and of low odour.

In the preparation of these foams the fluorotrichlorohydrocarbon is dissolved into either the resin or isocyanate. In one such system which we have studied intensively fluorotrichloromethane is dissolved in the isocyanate.

The density of foam obtained in any section not only depends on the foam formulation but upon the shape and size of cavity, the techniques of applications and conditions under which the foam is prepared. With these systems it is now possible to obtain overall densities of 2·0 lb./c.ft. or less in sections varying in thickness from 1½ in.–12 in. With the rigid foam system studied initially the foam density rose very rapidly when applied in thin sections. By increasing the fluorotrichloromethane content of the foam mix densities below 3·0 lb./c.ft. can be obtained in sections where the foam thickness is only ½ in. A number of methods of calculating the density of foam are in use. One method is to cut a small cube from the mass of foam, measure the volume and weight and calculate the density. This density is often referred to as the cube or nominal density. It is preferable, however, to state where possible an overall density which is calculated from the weight of material required to fill a section of specified volume. It has been found that the nominal density is generally appreciably lower since it does not take into account the higher density surface layer at the foam/facing material interface or any change which may occur due to designed variation in the dimensions of the cavity at specific points. This cube density, therefore, can be very misleading if used in the preparation of estimates or quotes for the application of foam by *in situ* methods.

In addition to density reductions the use of fluorotrichloromethane leads in closed cell polyurethane rigid foams to a number of most important technical effects—improved thermal insulation properties, reduced pressure build-up during the foaming process and better flow of the rising foam.

The thermal conductivity of a foam is governed mainly by the gas content of the cells and is a function of their molecular weight and cross section. This varies greatly as can be seen from the following examples.

	B.t.u./hr / sq.ft./°F./in.
Air	0·168
Carbon dioxide ...	0·102
Fluorotrichloromethane	0·058

In these fluorotrichloromethane/carbon dioxide or wholly fluorotrichloromethane blown foams the thermal conductivities have been found to be as low as 0·12 B.t.u./hr./sq.ft./°F./in. at a mean temperature of 0° C. when the foams are freshly prepared. There is some evidence which suggests that some of the fluorotrichloromethane may gradually diffuse out of the foam and be replaced by air.

After an initial period of some months when the thermal conductivity rises to 0·15 B.t.u. the rate of diffusion appears to be, if it occurs at all, very slow.

Under many normal working conditions this diffusion of the fluorotrichloromethane would be retarded even more by the fact that the foam is sealed in what is essentially a vapour-tight cavity and some support is given to this view by experimental work. The practical effect of these low K values on the technical and economic properties of the foam as an insulant will be discussed in more detail later in this paper.

With the fluorotrichloromethane/carbon dioxide blown foams the pressure developed whilst the foam is rising is much lower than that of the fully carbon dioxide blown foam. It is thought that this is due to the fact that the heat of reaction is used to volatilise the fluorotrichloromethane and this affects the rate of gelation of the foam. The rising foam is therefore in a more gelatinous state and therefore does not exert the same forces on the side of the structure. Similarly, the rising foam flows better, giving better distribution and reduced tendency for cavitation round obstructions which may exist in the cavity.

Machines

Many of the technical and economic difficulties associated with early attempts to use rigid polyurethane in the insulating industry could be directly attributed to the deficiency of the foam equipment.

The introduction of the low viscosity resins afforded the possibility of mixing the resin and isocyanate foam without the assistance of a mechanical stirrer. This type of gun has been developed for both spraying and dispensing rigid foam. (The basic mode of operation of the spray version of gun was shown in simplified diagrammatic form by the authors.)

Application Techniques

The development of these new raw materials and equipment has enabled the basis application techniques to be simplified.

Vertical Cavities

This type of section is filled by gradually building up a series of layers of foam. With the much smaller mixing head it is now easier to gain access into the cavity generally from the top. The weight of foam delivered can be controlled by timing as with the established systems but with the new equipment timers and revolution counters can be fitted onto the metering to control the flow of the liquid foam. Where the operator has easy access to the cavity and can clearly see the rising foam, the handleability of the equipment is such that he can deposit the liquid mix starting at one end of the cavity and working across keeping the flow of liquid slightly in advance of the rising foam. With experience the operator can help the height of rise to 9 in.–18 in. without the aid of timing devices. The time interval between lifts can be reduced under normal working conditions to the order of 30–40 secs. due to the fast reaction rate of the polyether systems.

With the poor intermittent action and high wastage factor of the older mixing heads it was necessary to plan long uninterrupted runs if the wastage of foam was not to be excessive. It is now possible with the finger control for cleaning and intermittent action to either place a few ounces of foam in position or tens of pounds with the wastage remaining at a negligible level. This can have a profound effect on the planning of a job for, whereas in the past it was absolutely necessary to plan the build-up of the job around the conditions required for the satisfactory working of the foam equipment, with the greater versatility of the new equipment and materials they fit more readily into the normal working conditions.

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The good flow properties of the foam and the excellent manoeuvrability of the mixing head which simplifies the distribution of the foaming reduces any tendency for the formation of voids round obstructions which may exist in the cavity.

Overhead Sections

As one would expect the reduced weight of the mixing head and improved handleability has had a marked effect on the amount of physical effort required when working on an overhead section.

The first step for insulating a roof with rigid foam is to divide the space between the facing panels and permanent structure into small subcavities. In the past this has been done with preformed blocks of insulant but now, particularly where the roof is already partially divided up by ground joists or stiffeners, it is possible to run a little of the mixed chemicals along the lines of division and allowing the mix to rise to form foam barriers. It is no longer necessary to control carefully the volume of each section for the foam is applied in a series of applications starting at the back of the cavities allowing each injection to rise before a further one is applied.

The waiting period between each injection is of the order of 30–45 secs. The running time for one injection is controlled either automatically from the metering unit or by the operator distributing the foam so that liquid foam is not applied onto rising foam.

This technique can be used in sections 3 in. thick and upwards. For normal working the depth of a section should not be much greater than 4 ft.

The facing panels in the roof area are erected in a series of strips ensuring that the panels are erected in sequence so that there is access to each cavity. The closing techniques for the final sections are similar to those already established, but are simplified by the fact that the foam can be injected easily through very small holes (7/16 in.).

Laminates

In recent years the demand for prefabricated insulating building units for both external and internal use has been increasing.

This type of panel can be made conveniently from rigid polyurethane foam.

The design and properties of the panels are largely controlled by their different end uses.

In the preparation of polyurethane rigid foam from Daltolac 41, Arcton 11 and Suprasec D, initial blending of the ingredients gives a free-flowing liquid, which is dispensed into the cavity to be insulated. As the mix subsequently expands and solidifies, it flows into and fills the cavity completely, including any irregularly-shaped spaces.

In order to obtain quantitative information on this point, four sectional chambers, each of 200 c.ft. internal capacity were constructed, and insulated with cork, glass wool, foamed polystyrene and polyurethane rigid foam respectively.

The chambers were constructed in accordance with normal commercial practice by the Anchor Insulating Co. Ltd., Woolwich Industrial Estate, Plumstead, London, S.E. 18, and were the same as a series of chambers supplied to the butchery trade, except that the refrigerating equipment was not fitted.

The chambers insulated with cork, glass wool and foamed polystyrene were identical. A 4 in. thickness of insulation was applied throughout, except in the doors where the thickness was 3 in. In the chamber insulated with polyurethane foam the thickness of insulation was 3 in. throughout, and the thickness of the structural timbers was reduced in proportion.

The chambers were built during August and September 1960 and the heat tests were carried out on them by J. & E. Hall Ltd., Dartford Iron Works, Dartford, Kent, during October 1960. The tests were carried out at temperatures above ambient since this was the most convenient technique to use, and also the one most suited to giving accurate comparative data.

The following description of the experimental techniques employed and the results obtained is given from the report on the tests by J. & E. Hall Ltd.

REPORT ON INSULATION TESTS ON SECTIONAL COLD CHAMBER

Details of Chambers

Four chambers were constructed each of 200 ft.^{3} nominal capacity.

The insulating materials used were :

Chamber A—Cork slab 6·5 lb./ft.^{3}

Chamber B—Expanded polystyrene 15 oz./ft^3.

Chamber C—Glass fibre in slab form 4·25 lb./ft.^{3}

Chamber D—(partially) Arcton blown polyurethane foam 1·8 lb./ft.^{3}

Construction was in accordance with normal sectional chamber practice and similar timber framework was used in each chamber. However, at the request of Imperial Chemical Industries Ltd., the thickness of insulation was 4 in. in the case of chambers A, B, and C and only 3 in. for chamber D. The doors on all chambers were insulated to 3 in. thickness.

Relevant chamber dimensions and data are given in table 1.

TABLE I

Chamber Dimensions	Chambers A, B, C	Chamber D	
External Height, in.	89	88	
Width, in.	81	79	
Depth, in.	72	70	
Internal Height, in.	78	78	
Width, in.	72	72	
Depth, in.	63	63	
External Surface Area, ft.^{2}	270	259	
Internal Surface Area, ft.^{2}	210	210	
Mean Surface Area, ft.^{2}	240	234	
% of Mean Surface comprising timber	16·7	17·1	Estimated
% of Mean Surface comprising 4 in. insulation	77·5	—	Estimated
% of Mean Surface comprising 3 in. insulation	5·8	82·9	Estimated

Test Equipment

Heat input to the chambers was accomplished by installing a nominal 300 w. of electric light bulbs in each chamber, together with a small air circulating fan. The electrical loading was measured by a single watt meter in conjunction with a 4-way switch.

Chamber internal temperature was measured by thermocouples near the centre of the ceiling and near the centre of the bottom of one wall. All thermocouples were 2–3 in. away from surfaces, and were protected from radiant heat.

Ambient temperatures around the chambers were measured 2–3 in. away from each face of each chamber, those beneath the floors being measured by thermocouple and the remainder by 1° steel cased mercury in glass thermometers.

The chambers were placed in line with 2 ft.–3 ft. between them and all were raised on timbers to about 6 in. above the floor.

Twenty-four-hour variations in the general workshop temperature

and in the internal chamber temperature for the cork insulated chamber were obtained by recording thermographs. That for the chamber internal temperature merely shows the variation, however, and is not calibrated absolutely.

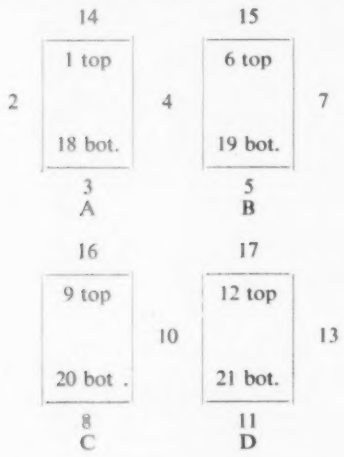
The key to the ambient temperature measurements around the chambers as shown in the log is given in Fig. 1.

Test Procedure

By experiment the heat input to the chambers was eventually adjusted to approximately 300 watts. This gave a temperature difference between inside and outside the chambers of the order of 50° F. This was considered satisfactory from the point of view of accuracy and was also unlikely to affect any of the insulating materials or the bitumen bondings.

FIGURE 1

THERMOMETER LOCATIONS



Temperatures in all the chambers were generally stabilized by October 12, although minor fluctuations were still caused by variation in the workshop temperature overnight. For the night of October 12/13, the workshop heating system was kept in operation and this considerably reduced internal chamber temperature variation. By midday on October 13, conditions had been steady for 24 hours and the log was concluded.

Results

Using a 6-hour period on October 12, apparent overall thermal conductivities were calculated based on the mean chamber surface areas and neglecting the effects of surface resistance and chamber lining materials.

Chamber A—Cork

Mean external temperature = 67° F.
Mean internal temperature = 112° F.
Heat input = 303 watts = 1033 B.t.u./hr.
Overall heat transmission rates $= \frac{1033}{240 \times (112-67)} = 0{\cdot}096$ B.t.u./hr. ft.²°F.
Apparent thermal conductivity based on 4 in. insulation $= 0{\cdot}096 \times 4 = 0{\cdot}384$ B.t.u./hr. ft.²°F. for 1 in.

Chamber B—Expanded Polystyrene

Mean external temperature = 66·6° F.
Mean internal temperature = 113° F.
Heat input = 302 watts = 1030 B.t.u./hr.
Overall heat transmission rates $= \frac{1030}{240 \times (113-66{\cdot}6)} = 0{\cdot}093$ B.t.u./hr. ft.²°F.
Apparent thermal conductivity based on 4 in. insulation = 0·372 B.t.u./hr. ft.²°F. for 1 in.

Chamber C—Glass Fibre

Mean external temperature = 66·8° F.
Mean internal temperature = 113° F.
Heat input = 303 watts = 1033 B.t.u./hr.
Overall heat transmission rates $= \frac{1033}{240 \times (113-66{\cdot}8)} = 0{\cdot}0935$ B.t.u./hr.ft.²°F.
Apparent thermal conductivity based on 4 in. insulation = 0·374 B.t.u./hr. ft.²°F. for 1 in.

Chamber D—Polyurethane

Mean external temperature = 66·3° F.
Mean internal temperature = 117° F.
Heat input = 299 watts = 1020 B.t.u./hr.
Overall heat transmission rates $= \frac{1020}{234 \times (117-66{\cdot}3)} = 0{\cdot}086$ B.t.u./hr. ft.²°F.
Apparent thermal conductivity based on 3 in. insulation = 0·258 B.t.u./hr. ft.²°F. for 1 in.

Discussion of the above Report

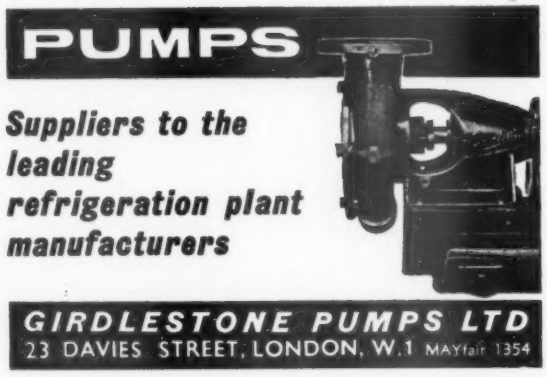
The results of the tests may be summarized as follows :

Chamber	Insulant employed	U. value (B.t.u./hr./ft.²/F./1 in. thick
A	Cork	0·384
B	Expanded polystyrene	0·372
C	Glass fibre	0·374
D	Polyurethane foam	0·258

The mean insulation temperature for all four chambers was approximately 90°F. (32°C.) and strictly the results hold for this temperature only.

It should be borne in mind, further, that the results given in the report include heat leakage through the timber framework and supports. The proportion of the mean surface area consisting of timber is 21 per cent. for the polyurethane foam chamber, and 17 per cent. for the other chambers. Results are therefore slightly biased against the urethane foam.

It may be claimed from these results that polyurethane rigid foam is at least 25 per cent. more effective as an insulant than the three other materials discussed in the report.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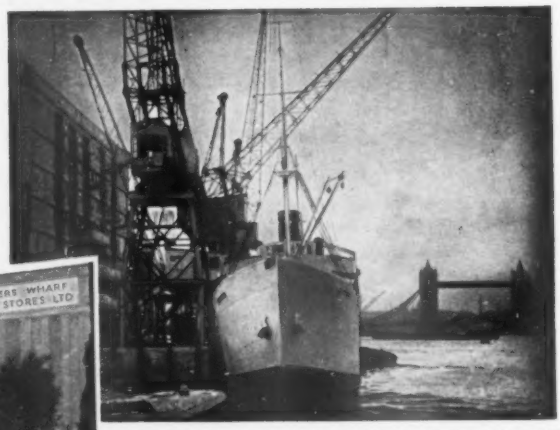

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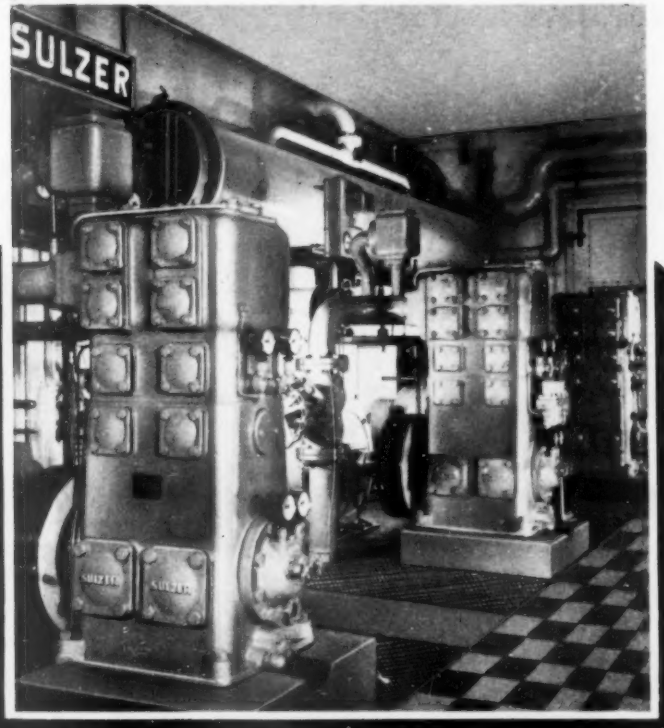

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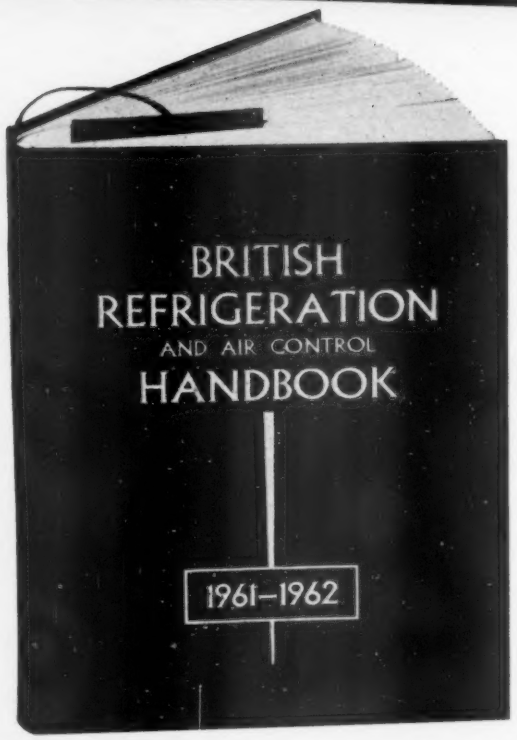

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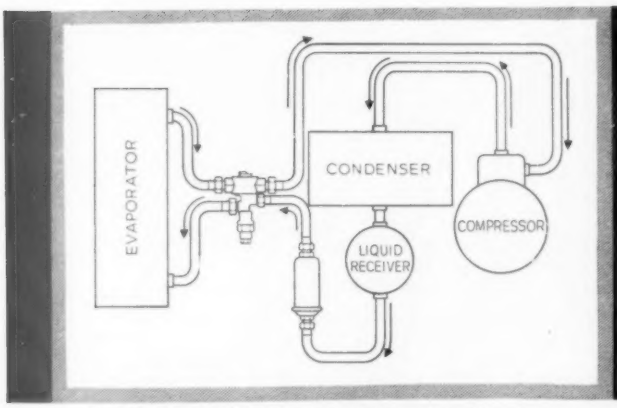

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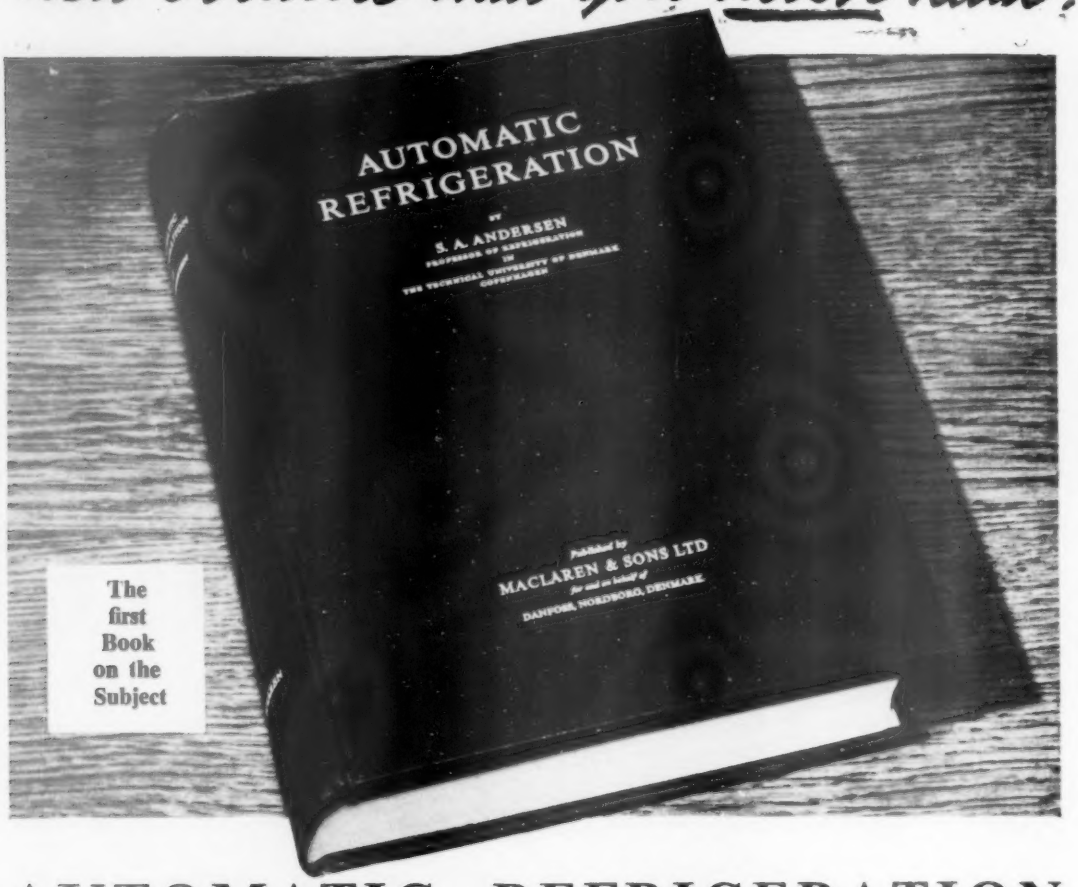

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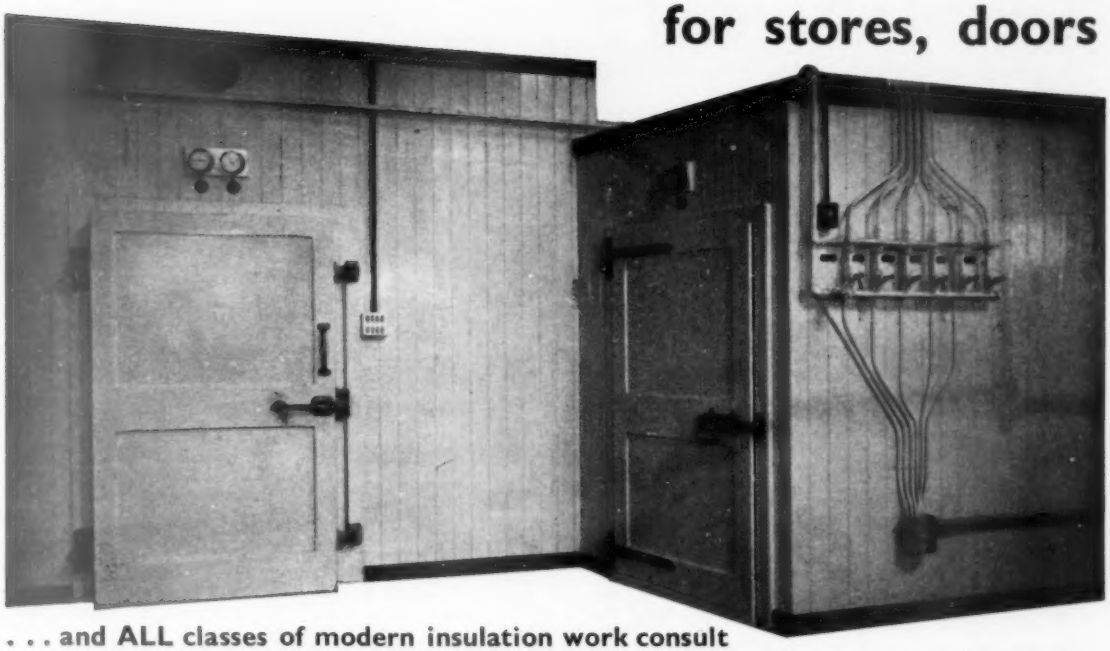

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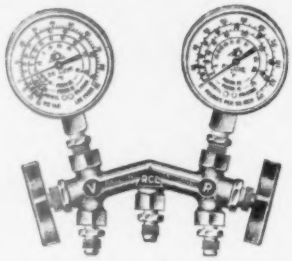

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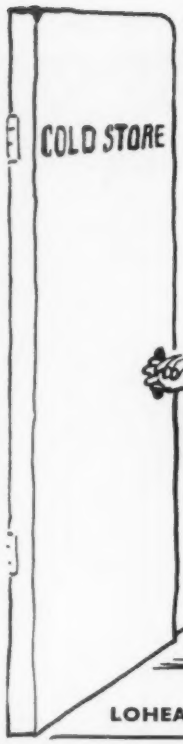

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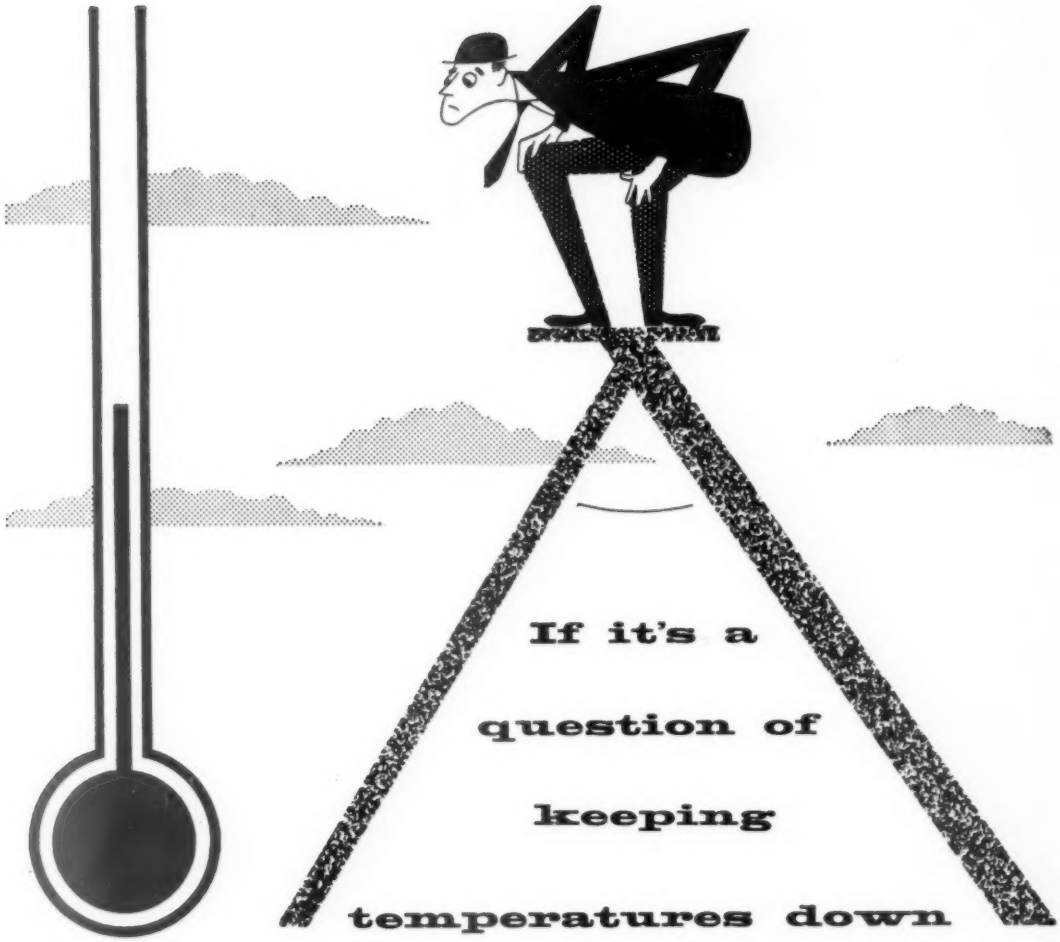

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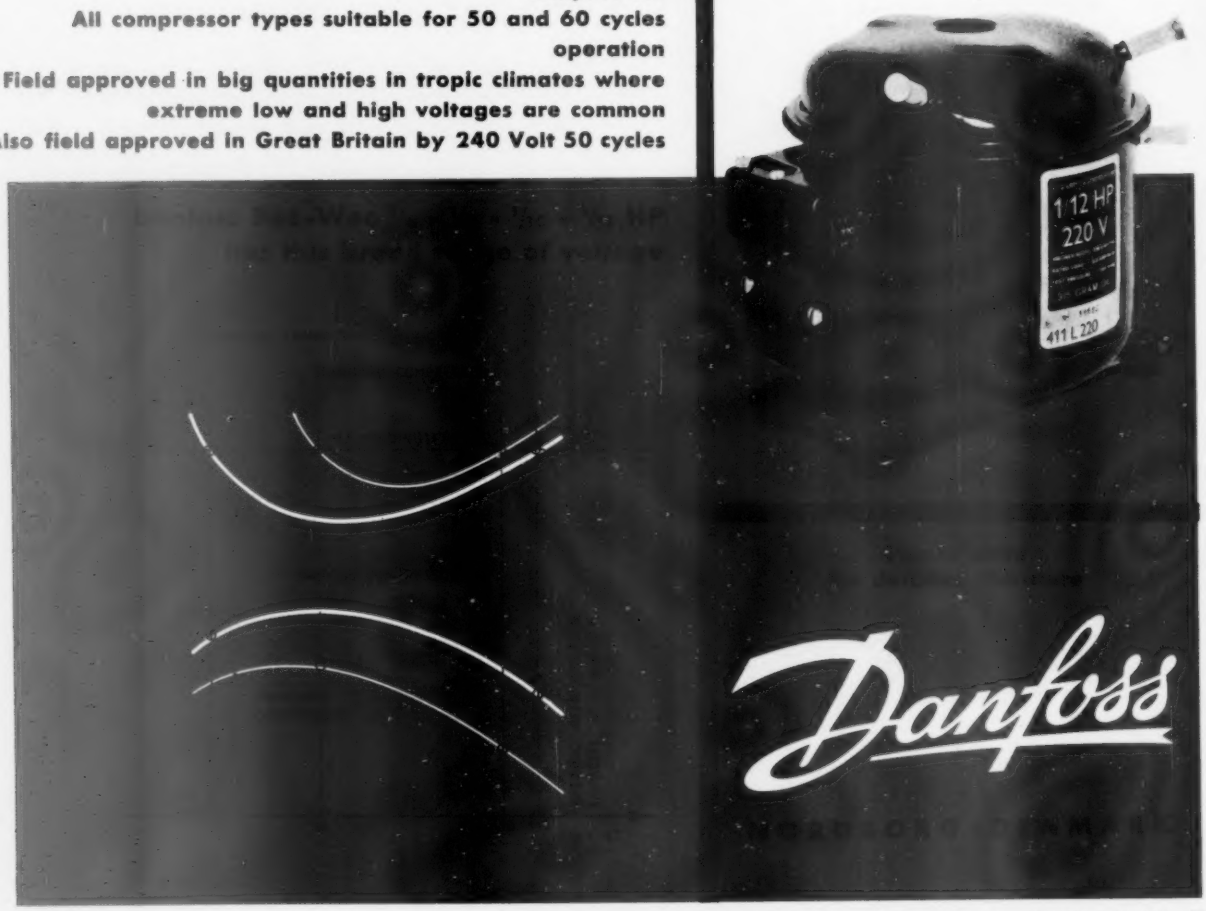

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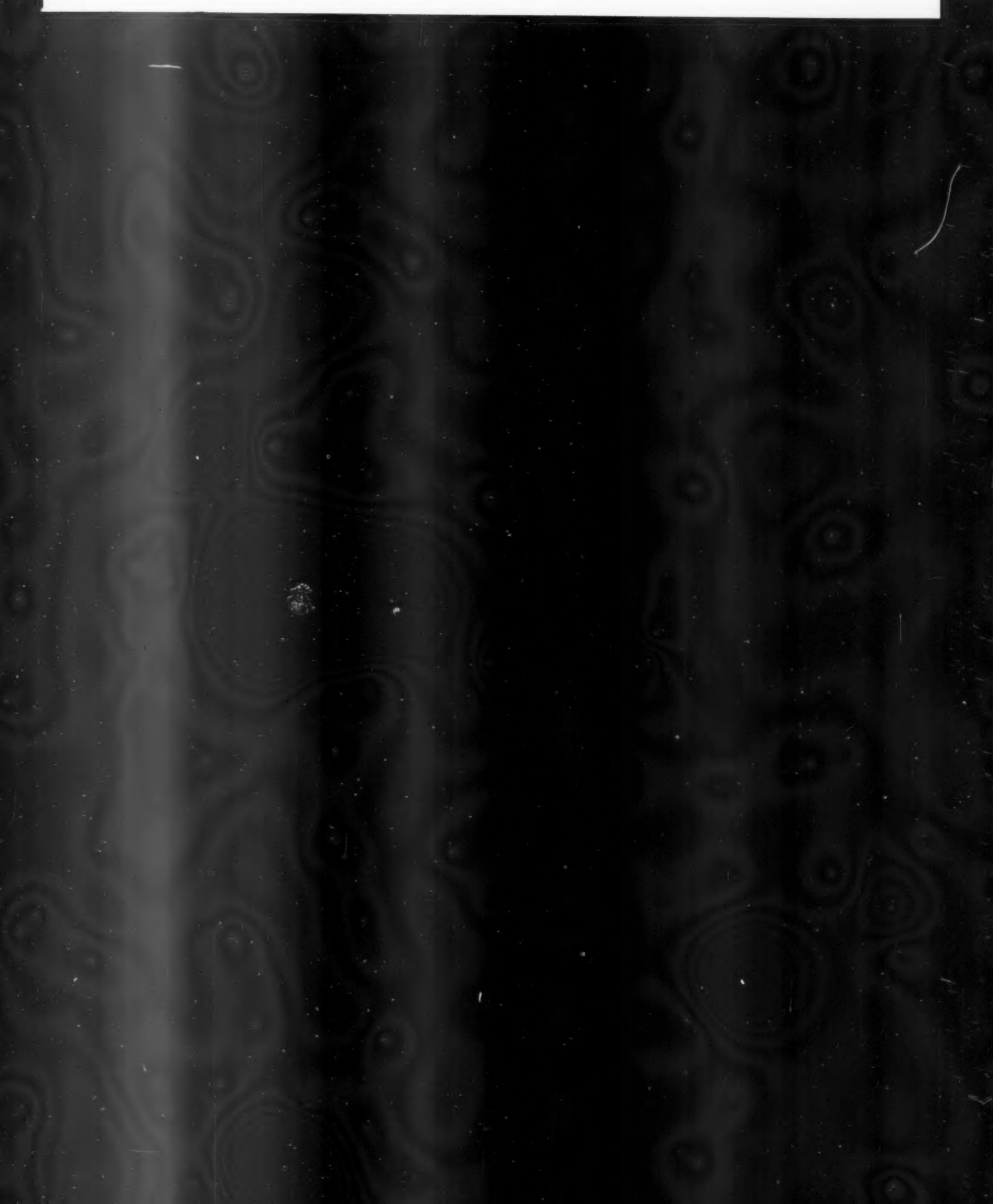
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